ROADS AND STREETS

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The Brecksville-Northfield High Level Bridge; on a By-Pass Route of the Cleveland Regional Plan.

Concrete Arch Construction
From Contractor's View Point

Arch and Deck Loads Carried Entirely by Falsework Made of Wood Piling and Timbers

By E. C. BLOSSER

Chief Engineer, Highway Construction Company.

TWO miles east of Brecksville, Ohio, on the Twinsburg-Eylria Road, a beautiful series of arches spans the Cuyahoga Valley; including the Baltimore & Ohio Railroad, the Cuyahoga River, a feeder canal for the American Steel and Wire Company and the dry bed ow the historic Cleveland-Pittsburgh Canal.

DESCRIPTION.

This highway bridge is a high-level structure 1,133 ft. long and 40 ft. wide. It has a 30-ft. brick roadway, with a 3½-ft. walk on each side. The granite-chip handrail and elaborate metal lamps add greatly to the beauty of the structure.

The five arches have a span of 181.25 ft. from center to center of piers. Each span has two 7-ft. arch ribs spaced 28 ft. center to center. Rising from these ribs ars narrow columns spaced at intervals of 19.25 ft., which of course carry the deck and sidewalks.

The design of the bridge can more readily be understood by closely examining Fig. 1.

Period of Construction.

The excavation was started on September 3, 1930, and construction was carried on throughout the winter, but only on a small scale. An average of not more than 55 men were employed during the winter. The object of the winter work was mostly to erect the falsework to carry the arch and deck concrete loads. With the falsework for three spans erected during the winter, we were able to get an early start with the form work, thus allowing us to pour concrete in the early spring. The excavation was also completed and a small portion of the concrete was poured during the winter season.

Fig. 1—General View After Completion.

Throughout the entire period of construction exceptionally good weather prevailed. The winter was mild; the summer was dry, and the two fall seasons were very dry and warm.

Excavation.

The excavation was classified into four classifications, namely, dry earth, wet earth, dry rock, and wet rock. The actual quantities compared with the estimated quantities are as follows:

Classification	Estimated Cubic Yds.	Actual Cubic Yds.	Difference Cubic Yds.
Dry Earth	4,170	4,002	Minus 168
Wet Earth	585	627	Plus 42
Dry Rock	540	637	Plus 97
Wet Rock	890	1,157	Plus 267

The excavation on the west approach was mostly dry earth, which was composed almost entirely of clay. The west abutment and west approach columns rest upon a dense blue clay, whereas the west arch abutment is keyed into 10 ft. of rock.

The excavation on the east approach was mostly of dry rock, due to the fact that all of the footings were keyed into rock, and the hill on this approach was so steep that only a small amount of earth remained.

The excavation in the flats went down through an average of about 9 ft. of wet and dry earth and into as much as 10 ft. of rock. The depth of the rock excavation at pier No. 1 was about 6.5 ft. and for pier No. 2 about 5.5 ft. The depth of the rock excavation at pier No. 3 was about 8.7 ft., and for pier No. 4 about 10.8 ft. It was necessary to excavate below the elevation shown on the plans for the retaining wall and pier No. 2. At this particular location the rock was very soft and lower than the test hole borings showed.

A cofferdam was required on three of the four piers and on the 160 ft. retaining wall. It was constructed of 20-ft. interlocking steel sheet piling (35 lbs. to sq. ft.) and 16-in. x 16-in. timber walers. Only two sets of walers were used because the sheeting was never driven through more than 12 ft. of earth. A 6-in. centrifugal self-priming Barnes pump was used to pump the water from the cofferdams. It was necessary to have a laborer take care of the pump continually throughout working hours. All of the earth excavation, except that on the east approach, was done by the clam-shell. The rock was broken up by air hammers and then shoveled into the clamshell and lifted out of the hole. Both the earth and rock excavation on the east approach was handled by hand. As the rock was broken up by the hammers, it was shoveled out of the hole and let roll down the hill. On this approach the bottom hole was excavated first and the concrete poured before the hole above it was started. By excavating in this manner, it was possible to backfill as the excavating progressed up the hill.

Supporting Arch and Deck Loads.

Description.—The arch and deck loads were carried entirely by falsework made of wood piling and timbers. The falsework consisted of large bents spaced 15 ft. on center and of the design shown in Figs. 2, 3, and 4.

Note that the large bent is composed of three small bents, called the bottom bent, middle bent and the top bent.

As you will note from the sketch, the top bent is a 56-ft. bent, the middle is a 40-ft. bent and the bottom will average about 45 ft. The radial bents that rest upon the 12-in. x 14-in. arch timbers and carry the arch loads, were from 3 ft. to 48 ft. high. These arch bents were formed by a 10-in. x 12-in. cap 10 ft. long placed upon two pilings. All of the other timber caps were 12-in. x 12 in. and 12 in. x 14 in. 30 and 40 ft. long. The ribbons and braces were 3x8's and 4x8's; the 4x8's being used on the bottom bents.

Erection.—The gasoline Erie crane that handled most of the piling and to which the 2½-ton McKiernan-Terry air hammer was attached, was operated from the top of the bottom bent or about 3 ft. above the top of the piers. It was gotten to this elevation by cribbing and ramping up the side of the east hill. This crane worked from the above mentioned elevation until it got to the east edge of the river; from there it established about a 7 per cent grade. By working from this steep grade and by

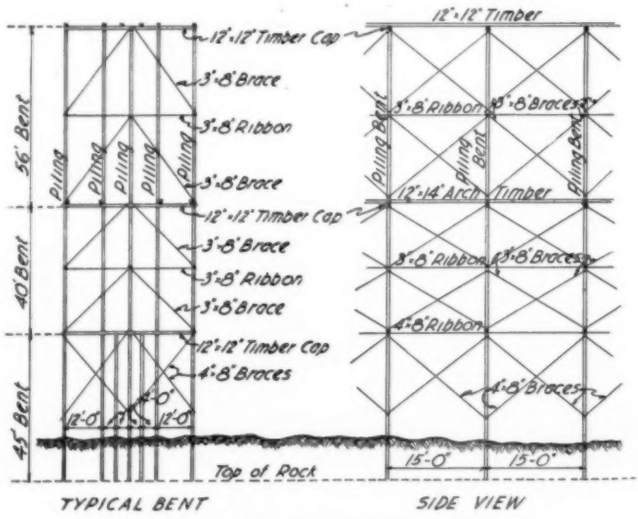

Fig. 2—Sketch of Typical Falsework Bents.

considerable cribbing, it was possible to land the crane on the west approach, where it was needed to finish the falsework.

The piling in the bottom bents were driven down to rock and cut off at the proper elevation. A 12-in. x 12-in. cap was placed on the top of the piling and the bent was then braced.

The crane would also turn around and set up the 40-ft. bent and after this bent was braced, it would lift the

56-ft. piling for the top bent and set them against this 40-ft. bent. The Sasgen derrick which was mounted on top of the falsework, would then pick up the 56-ft. piling and lift them the rest of the distance. The top bents were completed by the Sasgen derrick.

The Sasgen derrick would also set up the arch bents and place the joists for the arch ribs. This was done, however, after the falsework was completed for that span.

Hanging scaffolds were used to assist the carpenters in bolting the braces to the piling.

Wrecking.—A hook made of steel was placed in the

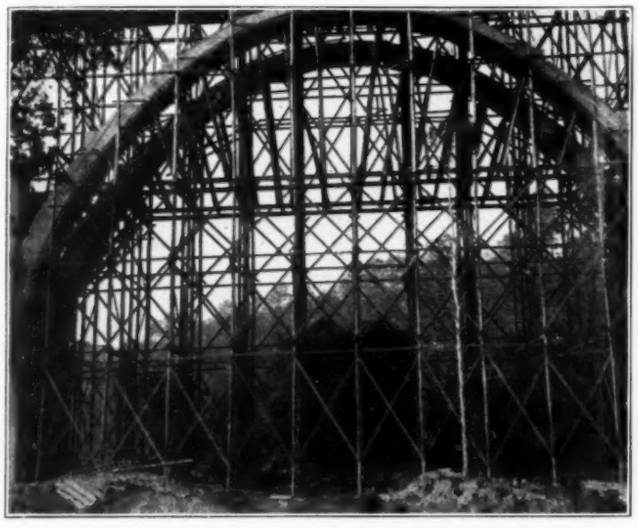

Fig. 3—Side View of Arch Centering.

bottom of the concrete deck slab directly above each bent. A snatch-block was hung from this hook and the piling and caps were let down by a tractor that was hitched to the end of a long wire cable.

The braces were, of course, removed before the piling could be let down. This work was done by men working on climbers; they would remove the bolts, tie the hand lines to the braces and assist in lowering them to the ground.

The falsework over the river and the railroad was lifted to the top of the bridge by a crane that operated from the finished roadway.

The piling under the arches were let down by snatch-blocks, cable and tractor, as described before. The bolts were removed and the sheeting for the bottom of the arch ribs was wrecked by men working on climbers.

Concrete.

Materials.—A special graded slag was used for the coarse aggregate; it was a No. 4 grading with the "fines" taken out. The sand was Grade "A" sand gotten from the Rubber City Sand Company of Akron, Ohio. The cement was trucked to the job from the Huron Cement plant in Cleveland, and was ordered as it was needed.

Concrete Mix.—All concrete was a 1:5½ mix. A six-sack batch was used throughout, which yielded 25.71 cu. ft. of concrete. The dry weight of the sand and slag used in each batch was, respectively, 1,500 lbs., and 1,240 lbs.

Batcher Plant.—The batcher plant was located about ¼ mile south of the bridge on the B. & O. R. R. Two spurs were built on about 7 ft. of fill and a 115-ton Blaw-Knox batcher was erected to the east of the railroad. The sand and slag were unloaded from the cars and piled into separate piles by a Browning steam crane, which had a 1½-cu. yd. clam-shell.

Batches of sand and slag were hauled to the mixing site and cement was put on each batch from a cement platform. The haul was from ¼ to ½ mile to the various mixing sites. The ½-mile haul to either end of the bridge included hauling the material up a long and steep hill.

Method of Handling.—On three of the four piers and the retaining wall, the concrete was hoisted into the forms by the crane. Concrete for pier No. 1 was run down chutes that ran from the top of the west abutment, over the railroad track, to pier No. 1. This same chute was used to pour the concrete for the west arch abutment and column pedestal No. 14. Chutes were also used to pour the east arch abutment and the east approach column footings and pedestals. All of the rest of the concrete was placed by a tramway. This tramway was composed of a 3-ton Plymouth engine and 4 Lakewood 32-cu. ft. radial gate hopper cars, which traveled on a 24-in. narrow gauge track.

The mixer, a 27-E Multifoote paver, was first placed on the east end of the bridge, at the south of the roadway and on the natural ground, which was 4 ft. above the pavement. The batch trucks, after getting the cement, would dump the batch into the skip of the mixer. After the concrete was mixed 1¼ minutes, it was discharged into a chute and let run down into the car. When two cars were filled the engine would pull them out onto the bridge while the other two cars were being filled. An average of 30 cu. yds. per hour was poured on the larger runs. Concrete was poured from this set-up until the haul was too long to be economical.

The mixer was moved to the west end of the bridge to pour the deck and sidewalks over Span No. 1 and the west approach.

Handrail.

Forms.—The forms for the granite-chip handrail were built in panels and handled by a two-boom derrick, which was operated by two hand winches. The

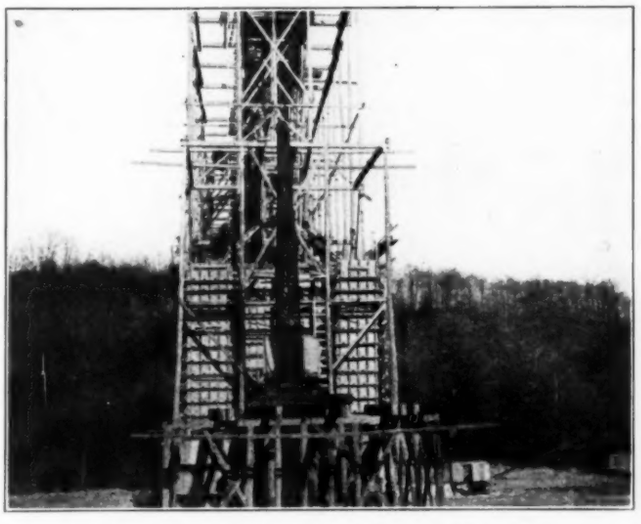

Fig. 4—Center Line View of Arch Centering.

derrick was used both for setting the forms and for wrecking the forms. The average length of the panels was 18 ft.

The posts were poured after the panels. Each post had 2-in. wooden outside forms and 1⅛-in. sheet metal bulkheads for the inside forms. Three ⅜-in. rods were used with the ⅛-in. sheet metal bulkhead to make the ½-in. open joint between the posts and the panels.

Concrete.—The concrete for the handrail was mixed

by a small mixer which handled a 2-bag batch. A batch consisted of the following:

5 cu. ft. of granite chips
3 cu. ft. of sand
2 bags of cement
10 lb. of hydrated lime.

The yield of this batch was 6.24 cu. ft.

The concrete was poured at 7 a. m. during warm weather, and by 1 p. m. the concrete had "set up" enough to allow the forms to be removed. As soon as the forms were removed the mortar was brushed out of the concrete, which gave the handrail a rough texture. Much

Fig. 5—Concrete Mixing Plant Setup.

care had to be taken with the removing of the forms and the brushing, because the corners of the railing were very easily broken. After the railing was thoroughly brushed, it was washed with a spray of water.

The following material was used for the 2,265 lin. ft. of handrail, which contained 163.46 cu. yd. of concrete:

1,433 bags of cement
7,140 lb. of hydrated lime
3,565 cu. ft. of granite chips
2,139 cu. ft. of sand
22,965 lb. of reinforcing steel.

Good luck seemed to prevail throughout the entire period of handrail construction. Of the 124 panels and 126 posts, only one panel and one post had to be taken out and rebuilt, which is very good for this type of handrail construction.

LIGHTING SYSTEM.

The lighting system is a 6.6 ampere series circuit of 60 cycles. It has two primary circuits, each lighting half of the lights. These primary circuits are so "hooked up" that if it be desired to burn but half of the lamps, the lighted lamps would be staggered across the bridge.

The primary wiring was single conductor 6,000-volt insulation with an outside lead sheath. The secondary wires were installed in 2-in. galvanized conduit, except at each end of the bridge where 3-in. galvanized conduit was used.

Each of the 36 lamps have an isolating current transformer of the manhole type, with primary and secondary disconnecting terminals. These Westinghouse style No. 348439, 4000/2500 lumen, 15-6.6 ampere transformers were placed in manholes beneath the sidewalk on the south side of the bridge.

There are 24 single light and 4 3-light Union Metal lamp standards on the bridge, equipped with Westinghouse lighting units. The unit consists of alabaster globes, canopy, standard film socket, Bi-lux refractor, etc.

The lamp posts were given two coats of statuary bronze after they were erected.

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Gas Toll Diversion Killed in Pennsylvania

Pennsylvania's road dollars will continue to be used for roads only. After a state-wide storm of protest against the appropriation of road funds for unemployment relief, a general sales tax of 1 per cent applying to nearly all commodities was recently adopted by the legislature. This was done in preference to diverting $12,000,000 from motorist-contributed road funds. This action requires all citizens to share in the general costs of government in proportion to their spending ability. Also thousands of men keep their road jobs and will not be placed on the dole lists.

* * *

TRUCKS PAY HEAVY.—Commercial use of highways has become so much a part of the nation's transportation system that commercial vehicles now pay more than a fourth of all motor vehicle taxes. The demand for quick, direct delivery recently led the railroads, through the Railway Express Agency, to establish inter-city express trucking service between Milwaukee, Chicago and South Bend. This activity may become national in scope.

* * *

ROAD DOLLAR FOR ROAD.—Because of declining revenues from automobile registration fees and gasoline taxes, it is more urgent than ever that states keep these road dollars for roads, declare highway authorities. The decline of motor usage has been a natural consequence of the business let-down, but highway travel still maintains a rapid pace. Current travel and the increase in motor usage expected with improved business conditions demand great mileages of improved surfaces, elevated grade separations, and by-passes around cities and towns.

▼

Statement by Secretary of Agriculture Arthur M. Hyde

Protests have come to my attention regarding the use by road contractors of cement and other material manufactured in other countries on roads supported by Federal funds.

Road construction is under the jurisdiction of the States and territories.

The Federal Government lacks authority to point out that the intent of Congress in passing emergency appropriations for the construction of public roads was to afford employment. That intent was not limited to those engaged directly in road building, but included as well those who would be engaged in the production of material. In my opinion, there is a strong, moral implication, arising from the emergency character of such appropriations, that preference in the materials used should be given to materials produced in this country.

▼

A colored laborer, doing a hauling job, was informed that he could not get his money until he had submitted an itemized statement. After much meditation he scribbled the following bill:

"3 comes and 3 goes at 4 bits a went—$3."—*From the Highway Magazine.*

FORTY BILLION DOLLARS *INVESTED IN ROADS,* Streets and Motor Vehicles

THE largest "public utility" in America is the highway system and its rolling stock. It represents an investment that is 50 per cent greater than the next largest "public utility," namely, the railways. The railway investment totals 27 billion dollars as compared with nearly 40 billions in highways, and highway vehicles. Of this huge sum about 17 billions are invested in roads and streets, and 23 billions in motor-vehicles, garages and filling stations. We include filling stations because they correspond with the fuel and water stations on railway lines. We exclude oil wells, etc., for they correspond with the coal mines which the railways do not own. In the following estimate the editors of ROADS AND STREETS aimed to secure a total highway industry investment comparable with that shown by the Interstate Commerce Commission as the total investment in railway plant. The latter includes large sums for right of way and terminal lands, but we have made no attempt to estimate the value of rights of way of highways. We have included an estimate of the cost of securing right of way easements.

This 40 billion dollar highway "plant" is perhaps the most remarkable development of modern times. During the 15 years ending in 1928 American motor-vehicles increased 19 fold in number. Road improvement lagged woefully behind this increase in rolling stock, for the mileage of "surfaced roads" only doubled during those 15 years. A "surfaced road" is one having a wheelway surfaced with gravel, macadam or some better type of hard surface.

A good many newspaper editors have spoken of so-called extravagance in road building without realizing that road building has lagged far behind the buying of automobiles. We have yet to read a single editorial condemning the public for buying too many automobiles. It would be a singularly foolish public that would invest more than 18 billion dollars in motor-vehicles and coincidentally fail to demand suitable roads over which to drive them.

Had there been two or three other industries whose expansion had equaled that of the motor-vehicle and highway industry, there would probably have been no overproduction of farm products, for capital and labor would have been diverted from agriculture. Call the buying of motor-cars "extravagance" if you please, but pray that inventors will invent other new marketable types of "extravagance"—television, what not.

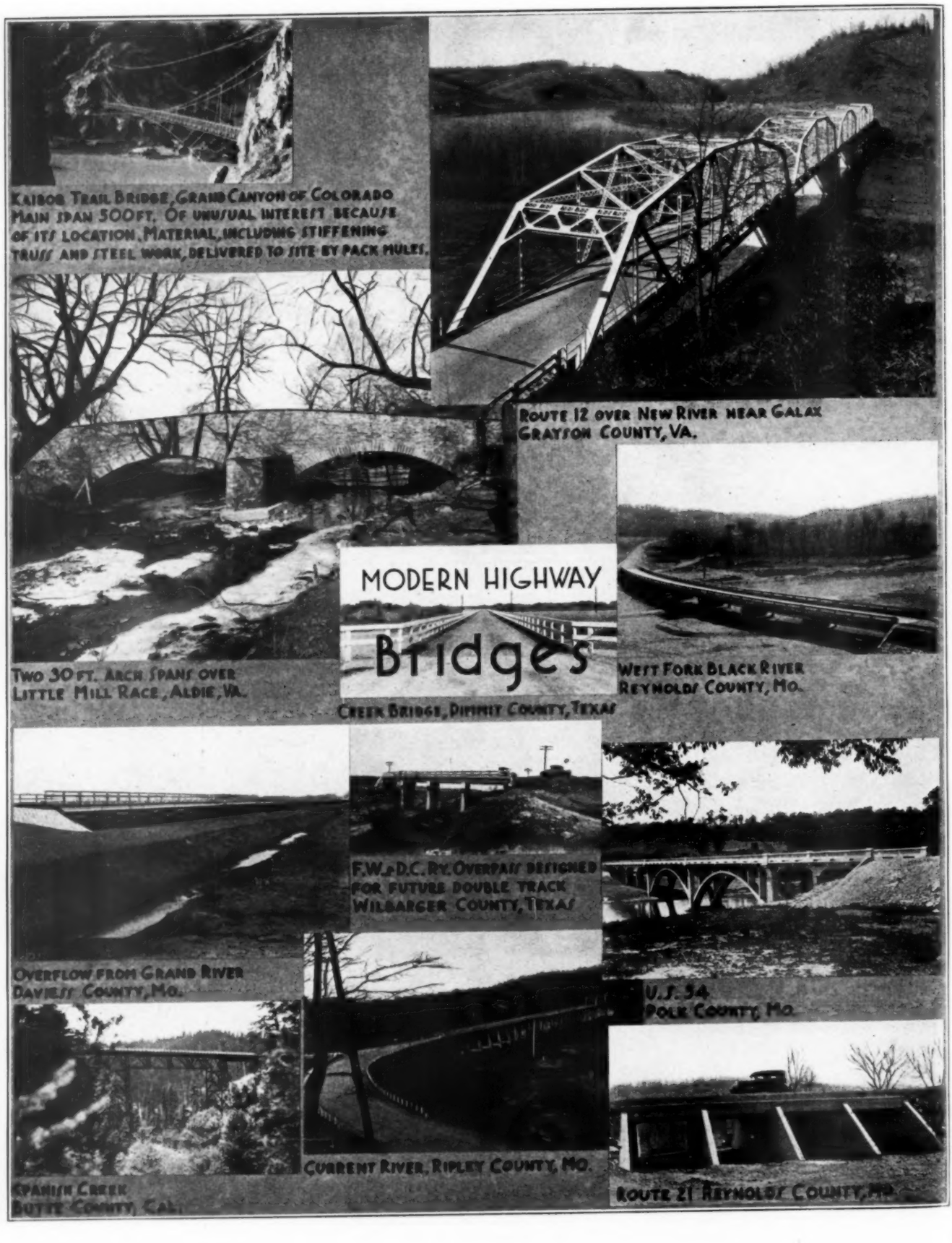
Including the new 1 ct. per gallon federal tax on gasoline, motor-vehicle owners would pay $700,000,000 annually in gasoline taxes, based on the 1931 consumption. To this add $350,000,000 in motor-vehicle license fees, and the annual "toll" for the use of the highways becomes $1,050,000,000. The annual cost of maintaining and repairing the roads is $450,000,000, leaving $600,000,000 as income, or 5 per cent on the 12 billion dollars invested in roads. Yet railroad executives are trying to persuade the public that highway users are subsidized by the public. If no gasoline taxes were diverted, our rural highways would be as self-supporting as our municipal waterworks.

Estimated
INVESTMENT IN ROADS AND STREETS

Roads:	
Federal (Parks, forests, etc.)	
176,000 miles at $3,000	$ 528,000,000
State (graded)	
35,000 miles at $5,000	175,000,000
State (surfaced)	
228,200 miles at $25,000	5,705,000,000
County and local (graded)	
2,278,000 miles at $500	1,139,000,000
County and local (surfaced)	
483,100 miles at $10,000	4,831,000,000
Right of Way (securing easements)	
3,200,000 miles at $100	320,000,000
Total Roads, 3,200,300 miles	$12,678,000,000
Streets:	
60,000 miles at $5,000	$ 300,000,000
140,000 miles at $30,000	4,200,000,000
Total Streets, 200,000 miles	$ 4,500,000,000
Motor Vehicles, 26,700,000 at $700	$18,690,000,000
Garages, at $100 per vehicle	2,670,000,000
Filling Stations (about 200,000)	1,400,000,000
Total vehicles, garages and filling stations	$22,760,000,000
Grand total	$39,938,000,000

TRAFFIC IN MINNESOTA SHOWS DECREASE — Travel on Minnesota trunk highways this year decreased 11 per cent as compared with last year, according to a traffic count made during the week of Aug. 1. Travel from Canadian provinces and other states of this country was shown to be 25 per cent lighter.

BEAUTY WITH UTILITY



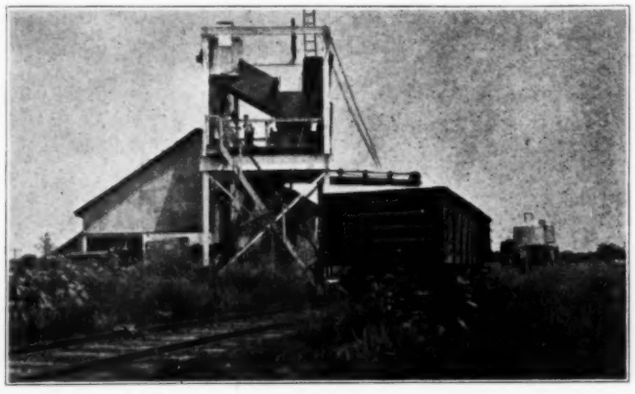
The Missouri-Kansas Rock Asphalt Deposits

By C. E. Heinz and W. F. Netzeband

Consulting Technologist; Consulting Geologist; Joplin, Mo.

THIS article, abstracted from numerous notes, was made possible through the cooperation of the producers of rock asphalt and those residents of the district who are familiar with the deposits of bituminous sandstone. These people gave much of their time and contributed much valuable data that this article might be a true resume of the industry as it exists today. Acknowledgments are also made to M. D. Harbaugh for his many helpful criticisms.

Historical Introduction—The occurrence of rock asphalts in Missouri and Kansas has been a matter of scientific record for more than 60 years. G. C. Broadhead



Plant of Kansas Rock Asphalt Co., Pleasanton, Kan.

reported on the Missouri deposits in 1872 and 1873 for the Missouri Geological Survey. B. D. Guthridge reports the finding of rock asphalt in a well dug in the southeast part of El Dorado Springs, Missouri, about 1882. G. H. Eldridge mentions rock asphalt deposits in Missouri in the 22d annual report to the U. S. Geological Survey in 1901, and Doctor C. L. Dake reports on it for the Missouri Bureau of Geology and Mines in 1918, "Sand and Gravel Resources of Missouri." M. Wilson also reports for the same Bureau in 1922, "Oil and Gas in Missouri." W. F. Pond and F. C. Greene repeat the study in their excellent report on the geology of Vernon County, Missouri, Vol. XIX, second series, 1926.

Mr. Haworth mentions the occurrence of bituminous rocks in Kansas in Vol. IX, of the University Geological Survey of Kansas, 1908.

Articles that have appeared in the technical press and textbooks pertaining to the bituminous industries, seldom mention this district as a source of supply for semi-impregnated bituminous sandstone or limestone. However, within the past few years much has been done by business men to stabilize this industry of preparing a processed paving material from these deposits, and in the past year new steps have been taken to place the business on a more substantial basis. Perhaps much of this change in status of the industry may be charged to the influx of technically trained men who have brought with them their wealth of experience gained in the mining and processing of other minerals.

Our detailed study of the Missouri-Kansas rock asphalts has indicated to us that these excellent road-making materials merit more study by private, state and federal engineers of road design.

Area of the Missouri-Kansas Rock Asphalt District—In this district almost 3,000 square miles are open to the prospector, but within this area the bituminous sandstones are not persistent but more or less spotted due to the structure of the rock formations. The better known deposits of bituminous sandstone are found in Barton, Vernon, Cedar and Lafayette Counties in Missouri, and Linn County in Kansas. Small deposits of bituminous sandstone have been reported from Pennsylvania outliers in surrounding counties but so far have not been developed. The better known bituminous limestones are found in Linn County, Kansas, and Cass, Dade and Barton Counties in Missouri.

Geology—All of the rock asphalts are sandstones or limestones, with gradations from an arenaceous limestone to a calcareous sandstone. In this area the asphaltic sandstones are found in the Cherokee, Henrietta, Pleasanton and Warrensburgh formations of Pennsylvanian age. Most of the material being exploited today is being obtained from the Clear Creek sandstone member of the Cherokee formation. These asphaltic sandstones are lens-shaped bodies with a maximum known thickness of less than 30 ft. and may taper off to a feather edge.

The asphaltic limestones are found in the Bethany

Plant of Universal Paving Co., Deerfield, Mo.

Falls member of the Kansas City formation, of Pennsylvanian age, and in the upper part of the Keokuk formation of Mississippian age. To date these asphaltic limestone deposits have not been extensively exploited. However, an experimental plant having a capacity of 30 tons per hour has been built to pulverize and process material from the Bethany Falls limestone. Due to the lack of field work and development work, the extent of the limestone partially impregnated with asphalt is not known at present.

Mineralogy—The asphaltic sandstones being used today are composed of quartz sand the grains of which have rough sub-angular faces which are well pitted and tend to be more or less water repelling because of their

affinity for bituminous substances. The grains are cemented together to a greater or lesser degree by one or more materials other than bitumen, and of these cementing materials, the bitumen is usually the weakest cement. Muscovite mica is a common constituent of most of the sandstones but its weight percentage is small. It occurs both disseminated throughout the mass and as thin seams, the latter separating the rocks into beds varying in thickness from a few inches to several feet.

The texture of the rocks may vary greatly within the

Plant of Reliance Rock Asphalt Corp., Ellis, Mo.

deposits and from one deposit to another. The maximum grain size of the quartz sand in any deposit is usually less than minus 28 plus 35 mesh Tyler screen, and the majority of the sand grains are found to be about 150 microns in diameter or about the 100 mesh Tyler screen.

The color of the bituminous sandstones varies from a brilliant sparkling black to a chocolate brown on freshly exposed surfaces and from a light gray to a light brown on weathered surfaces.

The known asphaltic portion of the Bethany Falls limestones as exposed near LaCygne, Kansas, and Westline, Missouri, is an oolitic limestone, gray to brown in color, with a texture varying from coarsely crystalline to dense. Areas of crystalline calcite up to 1 in. in diameter are fairly common. The limestone presents a pitted appearance due to the leaching of the cores of many of the oolites.

Very little is known of the Keokuk asphaltic limestones. Those studied near Arcola, Missouri, are coarsely crystalline, fossiliferous and practically free from chert. The color of the rock varies from a light gray to brown on freshly exposed surfaces and weathers to a dull yellowish-brown. Rocks high in bitumen are dull black from exposure and a brilliant black when freshly broken.

The Bitumen Content—The bitumen content may vary in the same deposit, both laterally and vertically, and may vary also from that of nearby or adjoining deposits. The total bitumen content may vary from a trace to as high as 14 per cent, by weight. The beds of sandstones, as defined by the mica seams may vary greatly in bitumen content and it is not unusual to find a rich bed overlying one much lower in bitumen content or vice versa.

The bitumen in the limestones occurs very spotty, but usually that portion of the deposit containing bitumen is saturated.

The characteristics of the bitumens vary greatly throughout the entire district, and this may be true in the same deposit. The bitumen may be a light oily fluid only slightly colored black, or it may be a hard, brittle solid, and in the deposits all gradations have been found between these two extremes. From a study of the bitumens much data have been collected that will be reported on at a later date.

It is this lack of uniformity of asphaltic content and rock stability that challenges the ingenuity of the engineer to quarry or mine and then process these minerals into a paving material, after the technologists have made their report on the fundamentals involved. On the other hand, several deposits are known which require no processing other than crushing.

The above statements may indicate to some readers that there are no deposits where the rocks are not fairly uniform, but this is not true. Beds of the rock may be from 4 ft. to more than 12 ft. thick and vary but slightly in asphaltic content; e. g., not more than 1 per cent say from 6 per cent to 7 per cent, while the beds above or below contain much less than 6 per cent. Other uniform deposits are known to contain a higher percentage of bitumen.

Quarries and Processing Plants

Commercial History—The asphalt industry in this area is closely linked with the shallow oil fields in adjacent territory.

Exploration for oil started in 1900. In 1901 several wells were drilled by the Missouri Oil and Development Company in the vicinity of Stotesbury, but no production was ever reported from these wells. It was not until 1920 that any intensive development of the oil fields was attempted. In that year the Minneapolis Oil and Refining Company drilled in the first known producing well near Richards. At about the same time officials of this company became interested in the reports of a heavy oily scum found on a pond near Sheldon in the southern part of Vernon County. Development in this area showed the oil sands to be near the surface and to contain a heavy asphaltic residue from which the lighter oils had evaporated. As this company was principally interested in oil, they first attempted to distill out the remaining heavy oils. The drop in the price of oil about this time discouraged further investigations and it was several years before any further attempts were

Quarry Hufty Rock Asphalt Co., Liberal, Mo.

made to discover a use for this material. Because for many years the importance of the rock asphalts as paving material was not generally known, the growth of the industry has been rather slow and erratic. Of late years the real worth of this local material for paving has been more generally recognized, and the nucleus of a large industry is in the making.

Quarries and Processing Plants—To better illustrate the scope and relationship of the several quarries and processing plants, they are described in the nature of a personally conducted tour through the district.

Starting in the extreme eastern end of the district,

about three miles east of El Dorado Springs, Cedar County, Missouri, we find a unique deposit of bituminous sandstone. On a knoll about 40 ft. above the surrounding terrain is a deposit 7 ft. or more thick with an overburden of about 6 ft. of soil, shale and thin-bedded sandstone. This deposit is being worked by the K. A. Spencer Co., of Pittsburg, Kan. The company is quarrying the rock, crushing, classifying and putting it on the road as a raw, untreated product. Under the direction of J. G. Spencer, superintendent of the company's operations, a detailed study of the deposit and of the best

Quarry Barton County Rock Asphalt Co., Iantha, Mo.

use that can be made of the product is being carried on. It is rumored that this company with its years of experience in stripping coal by means of some of the largest electric shovels ever built, is seriously considering entering the asphaltic paving material business on a large scale.

Leaving El Dorado Springs and traveling westward, we pass over U. S. Highway No. 54 and see one of the experimental projects of the Missouri State Highway Department. This project, for the study of asphaltic paving material made from deposits in all parts of the district, has used both raw crushed and processed materials. The Highway Department has given this project the most careful thought, and F. V. Reagel, Engineer of Materials, deserves the highest praise for his earnest efforts.

Continuing our westerly trip we reach Nevada, the county seat of Vernon County, and are impressed with the appearance of the rock asphalt pavement around the square. This pavement, made of local material, has been down for several years and is giving excellent service.

Traveling four miles west and less than one mile south from Nevada, we reach Ellis, a small town almost forgotten by the railroad but now the location of the processing plant of the Reliance Rock Asphalt Corporation of Independence, Kan. This plant is in charge of E. H. Crabtree, Jr. The flow sheet of this plant, which uses the continuous mix process, includes a gyratory crusher, rolls, vibrator screens, drier and pug mill. All operations are controlled from the laboratory which is in charge of Robert Crabtree. The quarry, located about ¼ mile to the northeast of the plant, exposes 7 to 10 ft. of bituminous sandstone with an overburden of 2 ft., mostly soil. The floor of the quarry is gray shale.

Returning to U. S. Highway No. 54, we continue westward to Deerfield, in Vernon County, where the plant of hte Universal Paving Company is in operation. At this plant the mixing unit is a portable plant known as the "Cummer Rock Asphalt Paving Plant." The crushing unit consists of a jaw crusher and a set of rolls, and is entirely separate from the mixing unit. This plant uses the batch mix process. The quarry of this plant is about three miles to the south. R. A. Thomas of Nevada is general superintendent in charge of plant and quarry.

A short distance northwest of Deerfield may be seen the strip pits of Mr. Belrose of Chicago. The equipment includes a steam shovel, drag line and a core drilling machine. These pits are not being operated at the present time.

Turning south over unimproved country roads, we reach Iantha in Barton County where the plant of the Barton County Rock Asphalt Co. is in operation under the direction of Joe S. Gill of Liberal. The flow sheet includes a jaw crusher, rolls and inclosed steam-heated pug mill. The continuous mix process is used. The quarry is one mile north and ½ mile west of Iantha. About 13 ft. of overburden is being stripped of which 4 to 5 ft. is soil and the rest a lean bituminous sandstone. From 9 to 11 ft. of bituminous sandstone of commercial grade is being taken. The quarry as opened up measures 35 ft. wide and 150 ft. from start of incline to the quarry face. Stripping extends about 75 ft. beyond the quarry face.

About one mile north and one mile west of the Barton County Rock Asphalt Company's quarry, we find the plant and mine of the Missouri Asphalt Sales and Engineering Corporation of Kansas City. This plant uses the continuous mix process. The flow sheet includes gyratory crusher, rolls, shaker screen and inclosed pug mill. This is the only company in the district mining rock by underground methods. It uses a Joplin type hoist, with cans to bring the crude rock into the plant hopper. There is an overburden of 12 ft. composed of 4 ft. of barren sandstone and soil and 8 ft. of lean bituminous sandstone. There is 18 ft. of commercial bituminous sandstone, but only 15 ft. is being mined leaving 3 ft. in the roof. It is reported that there is a second commercial bed 9 ft. below the floor of the one being worked. All plant operations are controlled from a laboratory located one mile south of the plant.

Leaving Iantha, we travel west and north to Liberal

Quarry K. A. Spencer Co., El Dorado Springs, Mo.

in Barton County to the plant and office of the Hufty Rock Asphalt Company. This plant uses no screens to size the product and uses the batch mix process. The flow sheet includes jaw crusher, rolls and pug mill. All machines have individual motor drives. Plant operations are controlled from the laboratory. The quarry located two miles north of the plant, as opened up measures 195 ft. by 45 ft. The overburden which has been stripped for about 100 ft. ahead of the quarry face, consists of about 18 ft. to 20 ft. of shales and soil and a thin bed of limestone just above the bituminous sandstone. Due to the topography, the average overburden is about 10 ft.

Traveling northwest from Liberal, our route carries us across the state line into Kansas and our next stop is Ft. Scott, Kan. After a short stay in Ft. Scott, we continue our trip northward to Pleasanton where the only Kansas operation is located. Here we find the plant and office of the Kansas Rock Asphalt Company in charge of W. P. Stoker, General Manager. Mr. Stoker has had previous experience with rock-asphalts in Oklahoma. This plant uses the batch mix process and, like the plant just left, uses no screens. It includes the usual jaw crusher unit and rolls, with drier installed before the pug mill. A unique feature of this plant is a suspended belt conveyor. The belt is reversible so that the product can be loaded either into a railroad car or into trucks. The quarry, located about three miles northwest of the plant has about 4 ft. of overburden of which 2 ft. is soil and the remainder barren, cross-bedded sandstone. There is about 6 ft. of bituminous sandstone exposed, but a core drill hole put down 25 ft. showed commercial rock to the bottom and apparently had not reached the bottom of the deposit. Several hundred yards to the northeast of the present quarry is a long bluff in which 11 to 12 ft. of bituminous sandstone is exposed.

If one is interested in undeveloped deposits, a trip north of Pleasanton to a point about five miles southwest of LaCygne, Kansas, rewards him with a chance to study an asphaltic limestone deposit. The limestone outcrops near the crest of a high hill and is exposed in two shallow pits. The asphalt content is spotty but very rich. The limestone is oolitic but gives a pitted appearance due to the leaching of the cores of many of the oolites. This deposit is the property of the Kansas Rock Asphalt Company.

Traveling northeast from LaCygne back into Missouri another asphaltic limestone deposit can be seen near Westline. This limestone is similar to that found at LaCygne. Here Mr. Roudebush has erected a plant to process this material. The crushing plant consists of a gyratory crusher and hammer mill. The crushed product goes into a large cylindrical steel hopper from which it can be drawn either directly into a railroad car to be used as raw crushed rock or elevated into a cylindrical drier and then fed through a portable "Cummer Paving Plant." The material is processed in batches.

A trip might be made to Joplin, Mo., where the Missouri State Highway Department has a short experimental strip west of town on U. S. Highway No. 66 which was put down in July, 1931, using processed rock asphalt from four different plants in this district. The material so far has withstood the unusually heavy traffic to which it is subjected and is in excellent condition. Although all four materials have stood up well, it is soon evident upon careful examination that some of the material is better than others, which only emphasizes that fact that careful processing is necessary to make a uniform product which will meet the conditions to which it is to be subjected.

Still "Higher" Mathematics

With the completion of differential equations, the law of diminishing returns begins to be rather conspicuous in the picture. There are, however, a few more mathematical subjects which can be useful to the engineer, if he stands in a position in his profession which places him near the scientist.

These are, in the order of their probable value:

(1) *Least Squares and Theory of Probability.* This subject cannot be considered a distinct branch of mathematics, but is often given as a college course. It finds its practical application in the adjustment of observations and determination of most probable values and of the probable error of any result of observations and determination of best equations of empirical curves from observed data.

Throughout his technical course, the student is brought into some contact with the theory and an entire lack of knowledge of it is a distinct deficiency in his training.

(2) *Vector Analysis.* This is a distinct branch invented (or, more properly, wrested from the arms of Quaternions) to enable us to handle problems in all kinds of quantities involving magnitude and direction. The student is introduced to it early in his course and makes considerable use of it in an elementary way, by the cumbersome method of resolving on co-ordinate planes to reduce the analysis to algebra. A formal course should clear up his haziness regarding this type of quantities, as well as give him a distinctly new vision and understanding of the ordinary geometrical precepts. Also, this subject has the advantage of being easily grasped, due to its geometric nature. Vector calculus is an extension of the subject of great interest and of much value as a mental stimulant.

(3) *Fourier's Series.* This subject, usually taught in connection with problems in harmonics, develops a method of expressing as one continuous, integrable function any "curve" made up of a number of ordinary algebraic functions. For example, a curve made up of a number of straight lines of different slopes, arcs of circles, ellipses, parabola, and what not, can be expressed in a single equation. The application comes in putting in the limiting conditions for solutions of differential equations, particularly in problems of potential, flow of heat, electricity, stream-line flow, harmonic periods, etc. It is practically wortthless to one who has not a good grasp of differential equations, but is a tool of inestimable value in the hands of the skilled mathematician.

(4) *Calculus of Variations.* Perhaps this should be omitted because it is probably not of practical utility to one engineer in a thousand (and also because the writer is profoundly ignorant on this subject himself). The subject develops a method of finding functions to fit given conditions (and particularly maximum and minimum functions) without knowing any relations among the variables or their derivatives, as is the case with differential equations. The method seems to have been invented to solve the problem of the path of quickest descent. Text books usually begin with an extremely abstruse proof, involving no assumptions whatever, that a straight line is the shortest distance between two points. As an application to mechanics, the writer has succeeded, by this method, in proving that radii remain straight in a round shaft under torsion, and that vertical lines on a beam remain straight when the beam is bent, these being our fundamental assumptions for computing stresses in beams and shafts.

Aside from any possible practical utility, the subject should have great value as a "head-stretcher"; but a head-stretcher is somewhat like a hat-stretcher, which cannot be made to function unless it can be gotten into the hat.—*Ohio Engineering Experiment Station Circular No. 27.*

ROADS IN EGYPT.—On April 30, 1931, Egypt had 4,160 miles of roads, of which 3,920 miles were dirt and 240 were hard surfaced (macadam). Alexandria has 560 miles of city streets. On Dec. 31, 1931, 29,368 automotive vehicles were registered, of which 17,897 were private passenger cars, 6,371 taxis, 3,848 trucks, and 1,252 busses.

FIGHT *Gas Tax Diversion! Ruinous Regulation! Unfair Taxation!*

Highway Transportation Has Carved a Niche for Itself in Our Economic Order and Must Not Be Stifled

CONTINUED imposition of taxation on motor cars and purchasers of gasoline, both by the federal government and the states, and the diversion during 1932 alone of almost $125,000,000 of money paid in through the gas tax in the various states has aroused the country and has resulted in the formation of the Highway Users' Conference, a national organization. Details of the organization of this Conference and of the formation of the first state body, known as the Illinois Highway Users' Conference, have now been assembled by ROADS AND STREETS magazine. These facts clearly indicate that the highway users of this nation are determined to fight for justice in the matter of taxation and the expenditures of funds paid in for road building purposes.

The Highway Users' Conference (National) sprung from a preliminary meeting of a score of automotive and associated national trade groups assembled in Washington, D. C., February 17, 1932. A larger meeting with 47 organizations represented convened in the nation's capital June 28, drew up articles of organization, and selected a national temporary chairman, who is Alfred P. Sloan, Jr., president of General Motors Corporation. Pyke Johnson, vice-president, National Automobile Chamber of Commerce, was named temporary secretary. An advisory committee was also selected.

Very recently national offices of the Conference were established in the Mills Building at Washington, and the Advisory Committee announced that Major Roy F. Britton, who has been president of the Automobile Club of Missouri for several years, and who is former state highway commissioner of that state, has been appointed General Manager of the Conference and is now on the job at Washington.

Illinois motor vehicle operators and other users of the highways were so enthusiastic about the national idea that they decided to be the first state group to incorporate, and on September 9 a state charter was granted to the Illinois Highway Users' Conference, the incorporators being M. Ready, president Ready Coal and Construction Company; Robert T. Hendrickson of the Hendrickson Motor Truck Company; and F. E. Ertsman, secretary of the Illinois Motor Truck Owners' Association. Mr. Ertsman is now acting as secretary of the Illinois Conference, with offices in the Lake-Michigan building, Chicago. Lafayette Markle, president of the Chicago Automobile Trade Association, is chairman of the Illinois Highway Users' Conference, and is actively engaged in organizing the numerous groups throughout the state in behalf of the purposes of the Conference.

Mr. Markle points out that Illinois is particularly concerned with the question of gas tax diversion at present because the Illinois legislature is in session, and many bills are before it which proposed further diversion of gas tax money for other state purposes, chiefly relief. The Illinois Conference contends that such diversion is not only unfair, but tends to eliminate thousands of workmen employed in road construction and associated industries, and thus to place these men and their families on the "dole," instead of letting them earn living wages through highway construction employment.

One of the immediate causes, perhaps the most important one, for the organization of the Highway Users' Conference (National) was the growing tendency to impose on road users general state charges, unrelated to road work, by means of diversion of money paid in through motor vehicle or gas taxes. In several instances the states have permitted or encouraged high gas tax rates to develop, simply to obtain funds for schools, unemployment relief, etc. The Highway Users' Conference (National) contends that such practice has been done without any attempt made to spread the burden over the general public. Logically enough, it is pointed out, users of the highway feel that their tax rates should be kept at that point where the cost to all road users is reasonable and the income sufficient to take care of construction and improvement.

The appended table shows the estimated state diversion for 1932, all from gasoline tax funds except as noted, and gives some idea of the tremendous strides already made in the use of gas tax money for other purposes than for which these funds were paid into the state treasury.

In its articles of organization, the Highway Users' Conference (National) gives as its purpose . . . . . "to encourage the development of equitable bases of taxation for the uses of public highways and to prevent imposition of undue burdens upon highway traffic. . . . ."

The Conference lists among its functions:

A. To act as a clearing house for the collection and dissemination to its members of information concerning present and proposed national, state and municipal legislation affecting motor vehicle taxation and regulation, and the taxation of products used in motor transportation.

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* New Ohio laws give the counties and cities half of the funds derived from gasoline taxes and motor license fees, all of which may be used for direct public relief.

** Borrowed, but will not be returned to road funds for a long time, if at all.

ESTIMATED STATE DIVERSIONS FOR 1932

(From gasoline tax funds, except where otherwise noted)

New York—General funds	$ 51,000,000
*Ohio—Unemployment relief (Possible)	27,000,000
Florida—General funds	2,000,000
All of motor fees to schools	4,750,000
Texas—Schools	7,500,000
Georgia—Schools	2,500,000
Louisiana—Docks	750,000
Schools	750,000
Tennessee—General funds ($2 of vehicle tax)	700 000
**Illinois—General funds (at least temporarily)	16,000,000
Oklahoma—Unemployment relief	2,000,000
New Mexico—Fish hatcheries	15,000
Mississippi—Sea Walls	250,000
Massachusetts—Local general funds (From gas tax and motor fees)	5,500,000
Rhode Island—General funds	1,000,000
Indiana—General funds (at least temporarily)	2,000,000
Utah—General funds (at least temporarily)	700,000
	$124,415,000

B. To study equitable policies of taxation for the provision and maintenance of public highways.

C. To serve as a meeting ground for the discussion of the policies of taxation of highway users and the problems of securing an adequate highway transportation system.

D. To act as an agency for coordinating as far as practicable the activities of its members in carrying out the purpose of the organization.

The Conference also issues this statement of principles:

1. Owners and operators of motor vehicles should be required to pay their proper share of the cost and upkeep of the highways.

2. Reasonable requirements of operation to safeguard against personal injury, property damage and damage to highways should be required of all highway users.

3. No highway user who has met reasonable requirements of taxation and operation should be subjected to further special taxation or governmental restriction of physical operations which would result in an unwarranted increase in the cost of using the highways.

4. Special taxes and fees which are imposed, directly or indirectly, for the use of highways should not be diverted to other governmental uses.

5. Uniform and reciprocal programs for taxation and regulation of physical operations of interstate movements of motor vehicles should be developed among the several states as far as practicable.

Any national, state, or regional organization, corporation or individual, who may be interested in the attainment of the objectives, of the purposes and principles outlined above, may become a member of the Highway Users' Conference, under certain restrictions; and each member will be entitled to one representative to present his views on all questions under consideration by the Conference.

The Advisory Committee, as selected in Washington in June consists of: Chester H. Gray, American Farm Bureau Federation; A. C. Pearson, National Publishers' Association; Ernest Smith, Executive Vice-President, A. A. A.; Alfred P. Sloan, Jr., President, General Motors Corporation; Amos L. Beaty, President American Petroleum Institute; George C. Clinton, International Milk Dealers Association; C. E. Child, National Industrial Traffic League; L. J. Tabor, National Grange; J. D. Tew, President, Rubber Manufacturers Association; Willard Chevalier, McGraw-Hill Publishing Company, Inc.; Herbert P. Sheets, Secretary, National Retail Hardware Association; John Simpson, President, Farmers' Union; C. O. Sherrill, Vice-President, Kroger Grocery & Baking Company; and E. C. Rice, American Bakers' Association.

Other groups represented at the preliminary meeting besides those shown in the advisory committee list include: American Automobile Association, American Association of Creamery Butter Mannfacturers, American Bottlers of Carbonated Beverages, American Farm Bureau Federation, American Petroleum Institute, Farmers' Union, International Association of Ice Cream Manufacturers, Institute of American Meat Packers, National Association of Motor Bus Operators, National Association of Retail Druggists, National Chain Store Association, National Grange, National Industrial Traffic League, National League of Commission Merchants, National Retail Drygoods Association, Rubber Manufacturers Association, and the National Automobile Chamber of Commerce.

Figures compiled by the National Automobile Chamber of Commerce give a further idea of extent to which the automobile industry is already taxed, and how much motorists contribute through the gas tax to governmental coffers now. It will be borne in mind that these statistics are for 1931 and that since July of this year many millions of dollars more have been added both by the federal government and by numerous states, as nearly all of the latter have increased their gas taxes or have in some way provided extra burdens for the highway user.

In 1931 passenger and commercial vehicle owners of the U. S. paid in $536,397,000 in gas taxes besides $334,337,654 in state motor license fees. The tax averaged 30 per cent of the total price of the gasoline— and in 1932 this percentage has increased. Thirty-four of the forty-eight states levied no general property tax for road costs, and 92 per cent of all current state highway income from tax sources is paid through special motor taxes. Although commercial vehicles compose only 14 per cent of the total number of cars on the road, this group paid $293,305,000, or 1/3 of the total taxes in 1931.

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National Paving Brick Association Convention

The Twenty-seventh Annual Meeting of the National Paving Brick Association will be held at Detroit, Mich., January 17-18, 1933. The National Paving Brick Association is one of the organizations participating in the Highway and Building Congress that will meet in Detroit during the same week. It will also have an exhibit at the Annual Road Show in the Municipal Airport building which will be staged in connection with the Congress.

The annual meeting will be held at the Book-Cadillac Hotel in Detroit and the sessions on January 18 will be open to the general public. Anyone interested in street and highway development is invited to attend.

The program, now under preparation, will be presented by prominent engineers, contractors and paving authorities. It will include descriptions of recently constructed brick highways, streets and boulevards. There will be discussions of the application of highway research to modern brick pavement design, including filler and cushion construction. How unemployment has been relieved by turning over and relaying old brick pavements, after a generation of service, will be described. Brick for resurfacing worn pavements and bases, an important and increasing utilization, will be a prominent feature of the program.

Mr. O. W. Renkert, Metropolitan Paving Brick Company, is president, and George F. Schlesinger, formerly State Highway Director of Ohio, is chief engineer and secretary of the association.

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Special Assessments

"Uniform Special Assessment Law" is the title of a a 42-page report of a special committee of the Investment Bankers' Association of America on Special Assessment Procedure. The report has been approved by the Municipal Securties Committee and adopted by the Board of Governors. It includes a discussion of problems incidental to special assessment financing, and comprehensive footnotes. It should prove to be an invaluable contribution to a division of municipal law which has been surrounded by many complex problems.

Serious abuses have attended the field of special assessment work and have been responsible for many of the difficulties of municipal finance today.

Subgrades—Characteristics, Classification and Remedial Measures

By Roger de L. French

Professor of Highway Engineering, McGill University, Montreal, Que.

IT IS only since about 1912 that any really comprehensive attempts have been made, first, to analyze the qualities of earth, our commonest construction material; second, to discover their relation to road construction; and, third, to cure their defects.

The Methods of Making Soil Investigations.—At the beginning, there were two distinct methods of approaching the subject. For lack of better terms we may call them those of the Russian and those of the American schools. The Russian investigators believed that the characteristics of a given soil, and therefore its behavior, could best be predicted from a knowledge of its geological history. Dokoutchaev, Sibirtzev, Glinka and their associates studied such features as origin, lime content, type of parent rock, character of hardpan layer, geological age and color. American students and those of most of the rest of the world, examined the physical, and to a limited extent the chemical, characteristics of soils, believing that the suitability or otherwise of a particular soil for a particular purpose could best be predicted from the information thus obtained. The two schools have stolen a good deal of each other's thunder, until now engineering soil investigations are in a state much like sanitary surveys. Just as the sanitary chemist insists on a thorough examination of the source of a water supply, as well as on an analysis of samples from it, before deciding whether or not it is suitable for use, so the highway engineer, or soil expert, insists on a thorough field examination as well as on numerous laboratory tests, before passing judgment upon a particular subgrade. Field examinations and laboratory tests are complementary: either without the other may be very misleading.

Field tests of a subgrade in situ would be ideal if any could be devised which would tell us just what would happen when the road concerned was built and in service, subject to all kinds of loading, rain, snow, frost, ground water and so forth. Unfortunately, no tests which will give the desired information in this manner are available, and the prospect that they will become so is not bright. Perhaps the most promising is the use of some sort of dynamometer which will measure the power required to pull a plow of standard design at a standard depth and standard speed through the subgrade. Such devices are available, notably one developed for quite another purpose at the Rothamsted Agricultural Experiment Station in Great Britain, but, so far as I know, it has never been used in soil studies. A dynamometer and plow would find the soft spots in a subgrade, but they would not yield other information equally essential, they could probably not be used in rough or forested country, and their use is open to still further objections.

After many years of work, much of which has proved to be of little direct value, a scheme for the classification of uniform soils has been developed, mainly by the investigators of the United States Bureau of Public Roads, among whom should be mentioned Terzaghi, Wintermeyer and Hogentogler. A place in this scheme may be found for any sub-grade of uniform character. Even with the relatively limited information now at hand, a fair prediction of the probable behavior of a subgrade of a particular uniform soil may be made. As greater correlation of classification and soil behavior is established, we shall become surer and surer of our predictions. The tests required to place a soil in the proper group are simple, cheap and rapid.

Characteristics of Eight Soil Groups.—Let us set out as briefly as possible the characteristics of the eight soil groups. Group A-1 has high internal friction and cohesion, and no harmful shrinkage, expansion, capillary or elasticity. It consists of well-graded coarse and fine material, with binder, and is very stable under load, either wet or dry. A subgrade of such material can be satisfactorily surface-treated, or can be given a relatively thin wearing surface.

Group A-2 soils have high internal friction and cohesion when fairly dry, and are therefore stable under load then, but may expand and contract with changing moisture content, become elastic when wet, and shrink and crack when very dry. Such soils make satisfactory subgrade if water is prevented from reaching them in quantity, and if they are also kept from drying out completely.

Group A-3 includes soils having high internal friction, but no cohesion, and little capillarity or elasticity. These are not stable by themselves, but make an excellent subgrade for moderate thickness flexible pavements or relatively thin rigid ones, if confined, since they are not much affected by frost, nor do they shrink or expand to any great extent.

In Group A-4, the internal friction is variable, and there is no appreciable cohesion nor elasticity. When dry or damp, these soils are quite stable, but they absorb water very readily, and may then become almost or quite liquid, and lose their supporting value.

The soils of Group A-5 are similar to those of Group A-4, but are highly elastic. They are difficult to consolidate, and generally require some treatment if to be used for the sub-grade of an important road.

Group A-6 includes the pure clays, with little internal friction but high cohesion and no elasticity. They expand and shrink to a detrimental amount. When undisturbed, they generally take up but little water, but if worked may absorb enough to become almost, or quite liquid, and very unstable, hence the not uncommon phenomenon of slips in clay fills. If fairly dry, and kept so, these soils are good subgrades, but are likely to heave under frost action.

Group A-7 soils are those of Group A-6, but in addition are elastic, and therefore more difficult to handle.

Group A-8 includes the peats and mucks, which are useless as subgrades, quite incapable of supporting even very light loads.

In addition to these "A" classes, there are "B" classes covering non-uniform subgrades, such as those due to sharp changes in soil character or field conditions, to non-uniform fills, and the like.

How Subgrade Classification Aids the Engineer.—The advantages of some such classification of subgrades are

manifest. In the first place, it provides a universal language, the meaning of which cannot be mistaken; there is much less chance of misunderstanding what is meant by a "soil of Group A-1" than by "sandy clay." With a precise classification such as this, the correlation of soil character and soil behavior can be made by observation of existing roads, and with a large enough body of knowledge of this kind built up in time predicting the future behavior of a certain soil should become relatively easy and reasonably certain, making it both possible and practicable for the engineer to prescribe in advance the treatment required to prevent road failures due to subgrade, with fair assurance of success, instead of waiting for defects to develop in the finished road, and then applying more or less uncertain measures in the hope that one of them may effect a cure. This is the generally current state of affairs. It reflects little credit upon highway engineers and contractors. Both would certainly be held in far higher lay esteem could the numerous annoying and sometimes serious road failures be reduced, or, hopeless ideal, be entirely eliminated.

Granted that it is now practicable by means of simple, cheap and rapid laboratory tests to place a subgrade soil in its proper class, and, from these tests and a field examination by a skilled engineer, foretell with some assurance the probable future history of the road to be built on a subgrade of this soil, what if the prediction be unfavorable? The road must be built, good or bad subgrade.

Remedial Measures.—There are many remedies available. The most obvious is relocation. One of the oldest and still widely used remedial measures is drainage.

When the road surface is pervious, as is the case with all earth and some bituminous types, and the subgrade is injuriously affected by water, waterproofing may be used. Light oiling of the subgrade surface has been practiced with success. Tar paper has been used under concrete pavements, both to prevent the loss of water by the concrete and the saturation of the soil.

Since sand has a low capillarity, it is sometimes used as a "blotter" over an absorbent subgrade to keep the water in the latter away from the surface, and to some extent to distribute traffic loads. If load distribution only is desired, a blanket course of larger material is better than sand.

A combination of the sand "blotter" and a gravel blanket course is being used in the province of Quebec on Route No. 1 between Granby and Magog. Six ins. of sand, mostly passing an 8-mesh screen, goes on top of the subgrade, which is generally of high capillarity. This is followed by 12 ins. of gravel, crushed if necessary, and all under 1¼ in. in size. Since this section of road is 32 miles long, and since it is planned to complete all grading before commencing to lay the asphaltic top, while maintaining traffic over the completed subgrade, the latter should be in good condition for surfacing by the time that step is reached, all soft spots having shown up and been made good.

A poor subgrade may often be greatly improved by the admixture of a suitable material. Perhaps the best example of the effect of a proper admixture is the sand-clay road, rare in Canada, but common enough in the South Atlantic states. Neither clay nor sand by itself makes a good road. Clay is exceedingly sticky when wet, and rough and dusty when dry. Sand may be quite satisfactory so long as it contains precisely the correct amount of moisture, as witness the Florida beaches, which are favorite automobile speedways, but it is loose and dusty, with high tractive resistance, when dry. Poor as these materials are separately, properly combined they make a low-cost surface which will successfully carry moderate densities of not too heavy traffic, and which is neither muddy when wet nor dusty when dry.

Generally speaking, admixtures reduce capillarity and increase internal friction, both of these improve the stability of the soil. It is possible that the cohesion may also be increased by admixtures, but this is doubtful.

The commonest admixtures are sand and gravel. Others which have been used with varying success are cement, light asphaltic oils and tars. Lime appears to be of little value if not actually harmful. The success of an admixture seems to lie in using the proper quantity and in mixing it thoroughly with the soil. No standard proportions can be given, since these vary. The method of mixing does not appear to be important, so long as it is thorough.

Possibly manipulation is the oldest method of improving subgrade quality. From the earliest days, specifications have required the rolling of subgrades, both to discover soft spots and for the improvement of stability and bearing value. Harrowing followed by rolling is used when the subgrade is not uniform; perfectly done it makes it so. Trucking over the rough subgrade is a cheap and simple method of consolidation, and is quite satisfactory provided rutting is avoided.

Sometimes the only method of securing a satisfactory subgrade is the complete removal of the poor material and its replacement by something better. In Canada, muskeg is perhaps most likely to require this treatment. This is largely decayed vegetable matter and is very wet. Eighty per cent or more may be moisture, while from 50 to 80 per cent of the solids are organic. These figures are from analyses of samples from the bogs referred to below.

On the Granby-Magog road there are three localities where muskeg has so far been encountered; across the Cherry river bog near Magog, at the crossing of the Canadian Pacific Railway at Delaire, and about 3 miles west of the latter point, near Eastman. The first two fills are on the line of the old road, the third is on relocation. A gravel fill was used across the Cherry river bog, where there is from 2 to 4 ft. of vegetable humus, and the muck was not removed, but merely displaced and compressed by the fill.

At the Delaire railway crossing about 2,000 cu. yds. of rock were placed in 200 ft. of 32-ft. road. Here nearly 5 tons of 60 per cent dynamite was used at the toe of the advancing fill to blow the muck forward and to the sides. Even this rather drastic treatment did not yield a firm bed for the fill, for there was some subsequent settlement, as evidenced by distinct surface waves in the bog at the sides of the road.

On the 900-ft. relocation near Eastman, fill in 10 ft. of muck is being made by another method of blasting. The sand fill is placed over the muck to a height of about 10 ft. above the final grade. Then a row of holes, 10 ft. apart in the row and on the center line of the fill, is put down. Each hole extends to the bottom of the bog, and is loaded with 40 lbs. of dynamite. The whole row is shot at once, making a long trench in the muck into which the sand fill falls. Then two similar rows of holes, 15 ft. each side of the centerline are driven, loaded with about 30 lbs. of explosive each, and shot simultaneously, allowing the rest of the fill to settle. This method of placing fill over soft material has not previously been used in Quebec, though it is not new.

Acknowledgement.—The foregoing is an abstract of a paper presented at the 1932 meeting of the Canadian Good Roads Association.

ROAD MATERIAL SURVEY METHODS

By D. G. RUNNER
Assistant Materials Engineer, U. S. Bureau of Public Roads

DURING recent years many state highway departments have adopted plans for the utilization of local deposits of rock, sand-gravel and other materials for use in the construction of roads and structures. The extent of this use of course has been dependent upon the quantity available and the ability of the material to meet specification requirements. In order to determine whether or not there is any local material suitable for road building, it is necessary that a survey for such material be made in the territory through which the proposed highway is to be constructed. It is the purpose of this paper to present a method for making such a material survey.

The procedure given in this report is one which was developed and used by the writer for a number of years in the state of West Virginia. The results obtained from these material surveys proved to be so valuable that they were made mandatory by the State Road Commission for all projects let for construction. It is believed that these material surveys, when properly made are of real economic value and should be used as a means of promoting the use of local supplies of rock, shale, sand-gravel, etc., where such material exists and meets specification requirements.

Low Cost Roads.—The following statements, taken from a recent report by C. N. Connor, indicates that there is a broad field for the ultilization of materials in the development and construction of low cost improved roads.[1]

"1. There is an immediate need for a large mileage of low cost improved roads having a traffic capacity of 300 to 1,500 vehicles per day exclusive of heavy trucks.

"2. The utilization of local, short-haul materials as surfacing or aggregate is the principal factor in keeping the cost of construction and maintenance at a minimum.

"3. Materials which are adaptable and suitable for untreated surfaces and which can be improved later by the addition of other types of surfacing, include stone, slag, gravel, limerock, marl, caliche, chert, shale, disintegrated granite, sand clay, and volcanic cinders.

"4. For bituminous surface treatments by the surface application and mixed-in-place methods, crushed aggregates which are hard and durable are preferred; they include crushed stone, crushed slag, and crushed gravel. Clean gravel and clean coarse sand are satisfactory and their cost is usually lower than that of the crushed aggregates."

Materials to Be Investigated.—The essential road building materials to be investigated during the course of a field survey may be divided into two general groups: namely, (1) rock and (2) sand-gravel. The rock group is further subdivided into igneous, sedimentary and metamorphic types. The general classification or grouping

[1]Report of Investigation of Low Cost Improved Roads, by C. N. Conner, Proceedings of the Seventh Annual Meeting of the Highway Research Board, Part II, 1927.

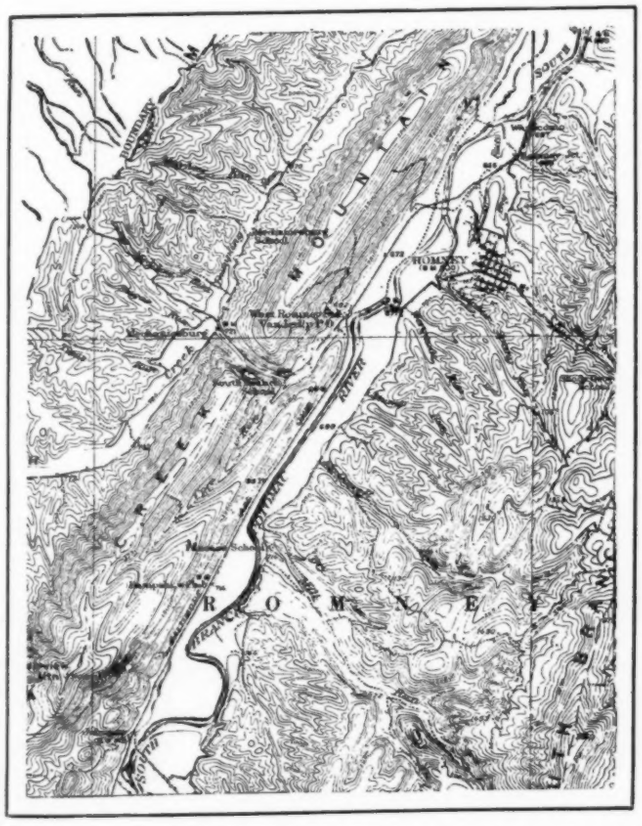


Fig. 1—Topographic Map of Region Encountered on a Material Survey.

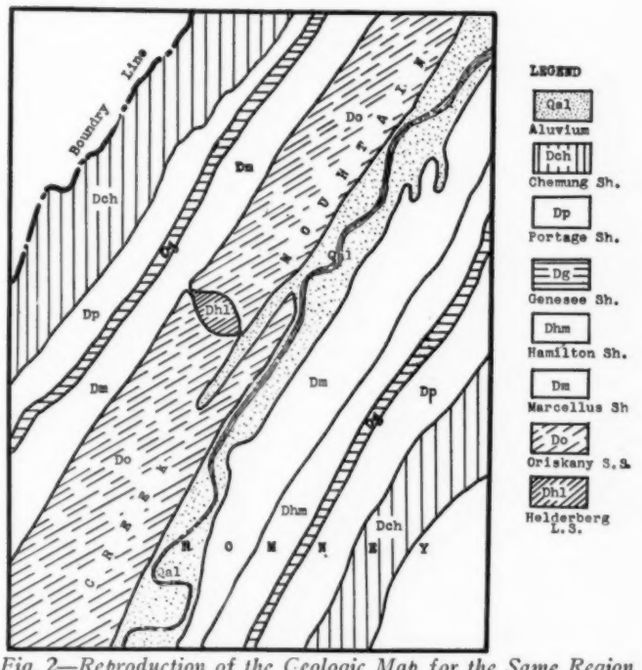


Fig. 2—Reproduction of the Geologic Map for the Same Region as Shown in Fig. 1.

TABLE I—GENERAL CLASSIFICATION OF ROCK[1]

Igneous	Intrusive (Plutonic)	Granite
		Syenite
		Diorite[2]
		Gabbro[2]
		Peridotite[2]
	Extrusive (Volcanic	Rhyolite
		Trachyte
		Andesite
		Basalt and Diabase[2]
Sedimentary[3]	Calcareous	Limestone
		Dolomite
	Siliceous	Shale
		Sandstone
		Chert (Flint)
Metamorphic	Foliated	Gneiss
		Schist
		Amphibolite
	Non-foliated	Slate
		Quartzite
		Eclogite
		Marble

[1]Table from U. S. Department of Agriculture Miscellaneous Publication No. 76, by D. O. Woolf, slightly revised.

[2]Dark colored, dense varieties are frequently referred to as "trap" rock.

[3]Sedimentary deposits also include the partly consolidated calcareous types such as limerock, marl, and caliche.

TABLE II—GENERAL CLASSIFICATION OF SAND-GRAVEL DEPOSITS ACCORDING TO TYPE

Glacial	Kames
	Eskers
	Frontal aprons
River	Flood plains
	Terraces
	Deltas
Beach	Sea
	Lake

of each, according to kind, is shown in Table I. A general classification of sand-gravel deposits is given in Table II. For more complete and thorough information regarding the origin of the sedimentary deposits, and the history of the igneous and metamorphic rocks, good geological text books should be consulted.

To be of real value a material survey must be carefully and accurately made, and the information obtained in the field must be complete in every detail. The finished report should present the data in such a manner that it will clearly show the quality, quantity, and acceptability of all available materials found along and adjacent to the proposed highway route. With this detailed information at hand one of the first steps toward the construction of the highway has been completed.

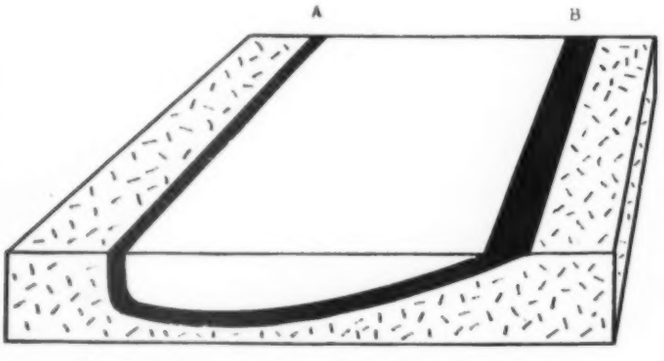


Fig. 3—Effect of Dip on the Thickness of Stratum.

Fig. 4—A Proposed Quarry Site. Note Jointing Structure of the Rock and the Angle of Dip.

The engineer in charge of the party making the material survey should have a general knowledge of geology, together with some experience in the laboratory testing of non-bituminous materials. Training in geology is essential as it enables one to differentiate between the different kinds of rock, their mineral components, type of fracture, and probable suitability for use in road construction.

In the field one skilled in stratigraphy is able to determine the amount of the dip of the strata, or the angle which the bed of rock makes with the horizontal, the probable lateral extent of the rock and the places most likely to show out-croppings. Laboratory experience is helpful in determining the kind of rock best suited for macadam or concrete, and whether or not sand-gravel deposits are of such quality as to permit their use in concrete, structures or as surfacing materials.

A survey party usually consists of the engineer in charge and one assistant. Additional men may be employed whenever it is found necessary. This occurs only when it is found necessary to dig a large number of test pits in sand-gravel deposits. The services of these additional helpers can generally be obtained locally and retained only so long as needed.

Field investigations for rock, shale, chert, etc., may be carried on the year round except in the extreme northern parts of the United States, where heavy snowfall covers the surface of the earth during the winter months. River and small stream deposits are best investigated during low water stages. Glacial formations and deposits of like character which are found in the northern states are better available for investigation during the summer months.

Equipment for Material Survey.—The following equipment has been found necessary in the execution of a material survey:

Light truck, ¼ to ½-ton capacity
Four and eight lb. sledges
Long handled shovels
Picks or mattocks
Pocket magnifying lens
Kodak and supply of films
Marking crayon
Two-gallon capacity buckets
Field note books
Sample bags and twine
Shipping tags and forms
Field screens and scales
Small bottle dilute HCL
Topographic and geologic sheets to cover area in which the survey is made.

Primary Investigation.—Before establishing a base for the party, a reconnaissance is made by the engineer in charge over the entire length of the proposed route. Dur-

Fig. 5—An Outcropping of Shale.

ing this preliminary inspection note is taken of all streams, out-croppings, the more prominent sand-gravel deposits and the general type of the topography. Figure 1 is an example of the topography encountered on a field survey in West Virginia. A detailed study of this map suggests the following items: The stream immediately offers possibilities of sand-gravel deposits, the close contours of "Creek Mountain" offer some possibilities of containing out-crops of rock and the smaller streams flowing into the major body of water may contain shallow formations of material. It has been found that the most likely places to find exposed rock are hilltops, steep hillsides, stream beds, cuts along roads and in other artificial excavations. Figure 2 is a reproduction of a geologic map of the same region as that shown in Fig. 1. In this map the different types and formations of rock are identified as to geologic name and stratigraphic position in the geologic time table. According to the legend accompanying the map, the symbols "Dhl," found in the center of the figure, denote an out-cropping of Helderberg limestone. This limestone is white in color and contains a considerable amount of chert. The thickness of the rock at this location is about 135 feet. The symbols "Do," found on the portion of the map marked "Creek Mountain," indicate that the material out-cropping there is Oriskany sandstone. The upper part of this formation is distinctly siliceous, sometimes white in color and sometimes reddish brown. The thickness of this rock varies from 350 to 375 ft. The sections of the map marked "Qal," bordering the banks of the south branch of the Potomac River, refers to alluvium, or soil and sand-gravel of recent deposit. A more complete discussion of the strata shown in this map may be found in the Hampshire and Hardy County Report, West Virginia Geological Survey, 1927.

Examination of Sites.—All possible material sites are marked on the topographic sheet to be referred to during the detailed investigation which is to be made later. Immediately following the reconnaissance, a thorough examination is made of each site noted during the preliminary inspection. In the case of rock formations, all outcrops are investigated for thickness, dip of strata, character of the rock, distance from the proposed route, quantity of material available, etc. The quantity of material in an out-crop is calculated by estimating the thickness and by pacing the lateral extent. The third dimension is dependent upon the dip of the strata and the amount of the overburden.

The dip of the strata, or the angle which the bed of the rock makes with the horizontal, determines the amount of material which can be economically removed. The block diagram in Fig. 3 shows the effect of the dip upon the thickness of the stratum exposed at the surface. Note the difference in apparent thickness of the same stratum at A and at B. A view of a proposed quarry site, having a sharp angle of dip, is shown in Fig. 4.

The samples of stone collected at each out-crop weigh about 40 lbs., and are taken from the fresh unweathered material. Where out-croppings show more than one kind of rock, samples are collected from each type. In working sites containing two or more strata of different rock it is almost impossible to keep the various kinds of material separated. Consequently, in making the physical tests, a composite sample is used. That is, the materials for test are combined in the same proportion as they are found in the quarry.

The hand lens is used for examining rock specimens to note the kind and character of the mineralogical content. Mineral constituents in fine grained, igneous rocks can hardly be determined by means of the hand lens. However, coarse grained igneous, metamorphic, and the more common types of sedimentary rocks may be identified by this means. The dilute HCL acid is used in determining the calcareous rocks. A pure limestone will effervesce freely when treated with this acid, while a dolomite shows little action if any. Sandstones containing a cementing medium of calcareous material will show slight action with the cold acid. Igneous rock, such as granite, syenite, trachyte, monzonite, etc., are not affected by acid.

Material surveys also include the investigation of shale, limerock, and marl deposits, within the economical hauling distances of the roadway. As in the case of rock, thickness of overburden, quantity available and other essential details are considered in investigating deposits of this kind. Samples of the materials are collected for chemical analyses, cementing value and other physical tests, to determine their suitability for surfacing or as a binder. Figure 5 is an illustration of an out-cropping of shale which was found suitable for use as surfacing material for a low cost road.

Sampling.—Extensive deposits of field stone and boulders are examined for quantity and quality. Details for the sampling of field stone and boulders are taken from Tentative Method T-2, A. A. S. H. O.:

"A detailed inspection of the deposits of field stone and boulders, over the area where the supply is to be obtained, shall be made. The different kinds of stone and its state of preservation in the various deposits shall be recorded.

"Separate samples shall be taken of all stone of different classes that a visual inspection indicates; from state of preservation and degrees of lamination, would be considered for use in construction.

Fig. 6—A Deposit of Field Stone and Boulders.

[2]For an interpretation of geologic maps see Field Geology, by F. H. Lahee, Chapter XVII, 1923, and Notes on Geological Map Reading, by A. Harker, Thomas Murby & Co., London.

Fig. 7—Bedding of Sand-Gravel in a River Laid Deposit.

"Records accompanying samples of field stone and boulders, in addition to general information, shall contain the following:

"(a) Location of supply.

"The plotting of the field stone and boulder area on a United States topographic or a similar map is recommended for this purpose.

"(b) Approximate quantity available.

"(c) Information regarding the percentage of different classes of stone which were sampled and percentages of material which can be rejected by visual examination and may have to be handled and spoiled."

Figure 6 shows a deposit of field stone and boulders, and illustrates the wide range in size of the material.

The detailed examination of sand-gravel deposits is more or less limited to the smaller streams and river terraces. At best, samples of the material may or may not represent the actual proportions of sand to gravel and the maximum range in size of the material. However, a field examination yields considerable information regarding the kind and extent of the material in the deposit.

Test Pits.—Investigating a deposit which has no open face often necessitates the digging of a number of test pits. The first pit is excavated to a diameter of 3 to 5 ft. and to a depth sufficient to enable a representative sample to be removed. In collecting the sample a shovel is held against the face of the material at the bottom of the hole. The shovel is then raised slowly, collecting the material as it is lifted. This "channeling" is done two or three times and the material is thoroughly mixed and quartered. A rough determination of the proportion of sand to gravel is then made upon the sample. If the analysis of the material warrants, a series of test pits are dug.

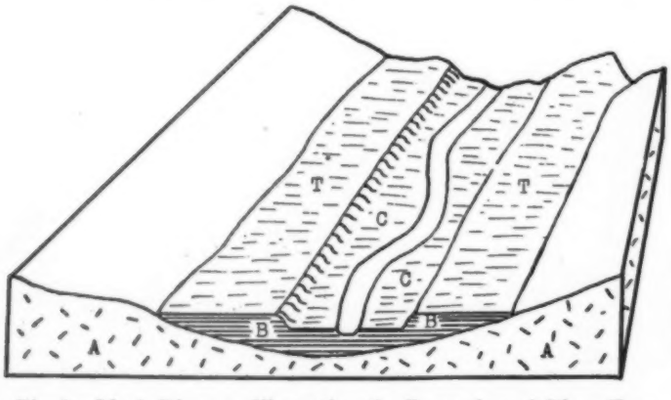


Fig. 8—Block Diagram Illustrating the Formation of River Terraces. A A, Section of River Cut Valley; B B, Alluvial Deposits of River; C C, New Flood Plain of River; T T, Former Flood Plain Now Forming Terraces (After Pierson).

The depth and number of such pits are determined largely by the results of the examination at the first pit. Where the extent of the deposit shows good material it has been found advisable to dig the test pits at intervals of 20 to 25 ft., radiating in all directions of the compass from the central or first test pit. These pits are deepened, and the material analyzed until the deposit "pinches out." By using the approximate depth determined in digging the pits, and by pacing the other two dimensions, the approximate amount of material available may be estimated.

If the sand-gravel deposit is a bank, or has an open face, samples may be collected by "channeling." Extreme care should be taken to prevent any of the overburden from falling into the sample as it is collected. Mechanical analyses are made on samples as stated in the preceding paragraph.

The bedding, usually found in sand-gravel deposits formed by stream action, is shown in Fig. 7. This deposit shows fairly uniform deposition of the material. The block diagram in Fig. 8 illustrates the formation of river terraces containing sand-gravel.[3] These terraces are usually formed as the stream, heavily burdened with

Fig. 9—Stream Deposit of Coarse Fragments.

sediments, reaches an even gradient. When the velocity of the stream is diminished, the carrying power is lessened and as a result the material is deposited.

Glacial debris, left in the form of moraines, kames, eskers, etc.,[4] over large sections of northern and northeastern United States consists of unconsolidated materials. This material ranges from clay-like sizes to boulders and fragments of rock several feet in diameter. In general the material in such deposits represents the kind of strata found in the region north of the Great Lakes and the St. Lawrence River.

Stream boulders, such as those shown in Fig. 9, are often suitable for surfacing material on low cost roads. There is generally a wide variation in the character of the material in deposits of this kind, and sampling depends upon the skill and experience of the engineer in charge. Oftentimes material from sources of this kind have proved advantageous and of value in regions where there is a scarcity of other material.

Records.—A complete note book record is kept of each sample collected during the field survey. A typical sheet from such a note book record is shown in Table III. This kind of a record is more or less adjustable and can be adapted to suit the local conditions and ideas of the person making the survey. It is believed though

[3] Text-Book of Geology, Part I, Physical Geology, L. V. Pirsson, p. 67.

[4] For an interesting discussion of glacial formations see The Story of Glacial Sands and Gravels, H. O. Whitnall, National Sand and Gravel Bulletin, July, August and September, 1929.

TABLE III—TYPICAL FIELD NOTEBOOK RECORD SHEET

Date: March 21, 1931
Project No.....3509-C, Route 42
Division No.....VII
County .....Oneida
Length of project.....6.72 miles
Field sample No.....14
Kind of material.....Biotite granite
Location of site.....Left of station 461 + 00
Owner of property.....H. J. Brown, Newberg, W. Va.
Estimated quantity available.....10,000 cubic yards
Grade and condition of haulway..2% ..... fair
Source of water supply.....Middle Creek
If rock, kind of fracture.....Good
Dump site for waste material....Near quarry site
Kind and depth of overburden....4 feet clayey soil
If gravel, per cent sand.....
Approx. range in size of gravel..
Distance from material site to job. 1,100 feet
Kind of crusher site available....Good, near site
Date sample shipped to laboratory. March 23, 1931.

TABLE V—TYPICAL DETAILED DESCRIPTION OF A MATERIAL SITE

FIELD SAMPLE NO. 17.
LABORATORY NO. 33703.
COUNTY: Warren.
PROJECT NO. 3300-C.
LOCATION: Right station 522 + 05.
KIND OF ROCK: A brown, fine grained sandstone.
OVERBURDEN: 5 feet of shaly sandstone.
KIND OF HAULWAY: Corduroy road having a 3 per cent grade.
OWNER OF PROPERTY: Harry Wilson, Oak Vale, W. Va.
ESTIMATED QUANTITY AVAILABLE: 15,000 cubic yards.
PER CENT OF WEAR: 5.1.
ABSORPTION IN PER CENT: 2.31.
SUITABLE FOR USE IN: Telford, knapped and broken stone base.
SOURCE OF WATER SUPPLY: Elkton River.
DUMP SITE FOR WASTE MATERIAL: Near location.
MICROSCOPIC EXAMINATION OF ROCK SHOWS: Moderately close grained structure. Minerals are quartz, magnetite, a small amount of muscovite and weathered feldspar.
REMARKS: Sample was taken from a massive ledge of sandstone outcropping about 30 feet above existing road-bed. The exposed face of the stratum approximates 600 feet in lateral extent by 25 feet in thickness. The overburden can be wasted at a "fill" about 200 yards from quarry site.

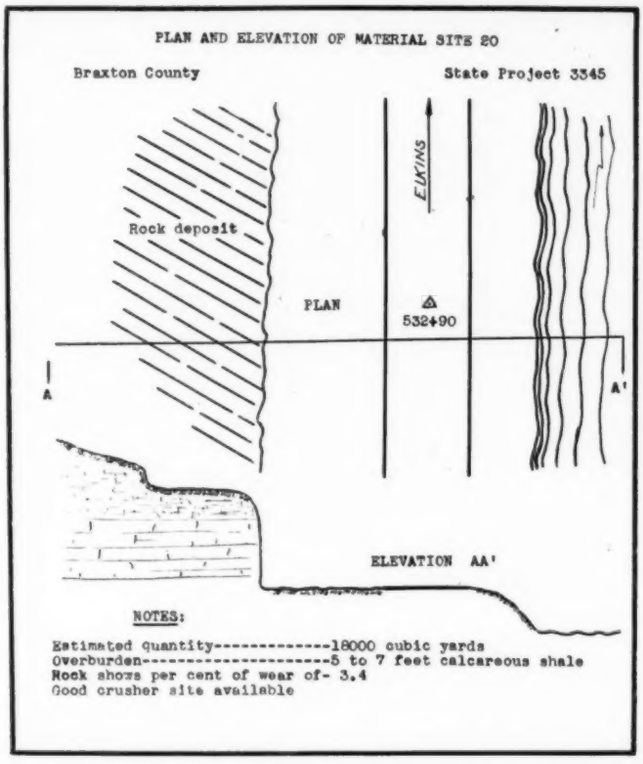


Fig. 10—Plan and Elevation of Proposed Quarry Site.

that the items given in this table will suffice for all except the most unusual cases.

The locations from which samples are collected are marked upon the topographic sheet covering the region surveyed. This map accompanies the final report, and shows at a glance the location of all possible sources of supply.

As a final check, the entire project is inspected again to make certain that all possible material sites have been located, and that all samples have been collected. The samples are shipped to the testing laboratory as quickly as possible. By this prompt shipment the routine test-

TABLE IV—TYPICAL SHEET SHOWING SUMMARY OF MATERIALS SURVEY. MERCER COUNTY—PROJECT 3300-A

Laboratory No.	Kind of Material	Field Sample No.	Station Location	Form of Deposit	Estimate Cu. Yds.	Distance from Road, Feet	Owner	Wear Per Cent	Sand Per Cent
23483	S.S.	1	263 + 00	Ledge	4,000	R. of W.	W. Johnson	3.8	....
23492	Shale*	2	275 + 00	Outcrop	10,000	R. of W.	J. K. Hill	...	....
23484	S.S.	3	407 + 42	Ledge	3,000	150 L.	C. Johnson	2.5	....
23485	S.S.	4	404 + 00	Ledge	10,000	30 R.	Ed. Cecil	2.0	....
23486	Sand-gravel	5	460 + 07	Terrace	2,500	560 R.	C. Johnson	...	30.0
23487	L.S.	6	483 + 55	Ledge	10,000	400 R.	D. A. Johnson	3.4	....
23488	S.S.	7	467 + 09	Ledge	2,000	200 L.	C. C. Smith	2.1	....
23493	Shale*	8	449 + 00	Outcrop	2,500	150 R.	C. C. Smith	...	....
23489	L.S.	9	441 + 00	Ledge	5,000	800 L.	C. C. Smith	3.0	....
23494	Cal. S.S.	10	443 + 08	Ledge	3,000	50 R.	G. F. Jones	2.9	....
23495	L.S.	11	413 + 50	Ledge	3,000	200 L.	Mrs. Brink	3.3	....
23500	Shale*	12	395 + 55	Outcrop	1,500	250 L.	V. B. Hull	...	....
23496	S.S.	13	390 + 00	Ledge	2,000	50 L	E. E. Reed	1.9	....
23497	S.S.	14	256 + 00	Ledge	3,000	75 L.	J. J. Hoyt	2.4	....
23498	S.S.	15	310 + 00	Field St.	500	250 L.	E. E. White	2.4	....
23499	Sand-gravel	16	382 + 80	Flood plain	3,500	1,000 L.	E. E. Reed	...	20.0
23509	L.S.	17	483 + 56	Ledge	10,000	¼ Mi. L.	N. A. Bogges	3.0	....
23510	S.S.	18	506 + 00	Ledge	3,000	300 L.	A. R. Jones	2.3	....
23511	S.S.	19	747 + 00	Ledge	4,000	R. of W.	H. T. White	3.2	....
23512	L.S.	20	744 + 00	Ledge	5,000	R. of W.	H. T. White	3.4	....
23513	L.S.	21	724 + 00	Ledge	3,000	R. of W.	W. Perdue	3.6	....
23514	L.S.	22	665 + 41	Ledge	10,000	100 R.	A. D. Preston	4.0	....
23518	Shale*	23	684 + 00	Outcrop	1,000	R. of W.	H. H. Hale	...	....
23519	Sand-gravel	24	699 + 00	Terrace	3,000	650 R.	H. J. Hull	...	45.0
23520	Sand-gravel	25	700 + 08	Terrace	4,500	700 L.	K. L. Green	...	35.0
23523	Sand-gravel	26	790 + 65	Terrace	4,000	500 L.	G. H. Hoyt	...	32.0

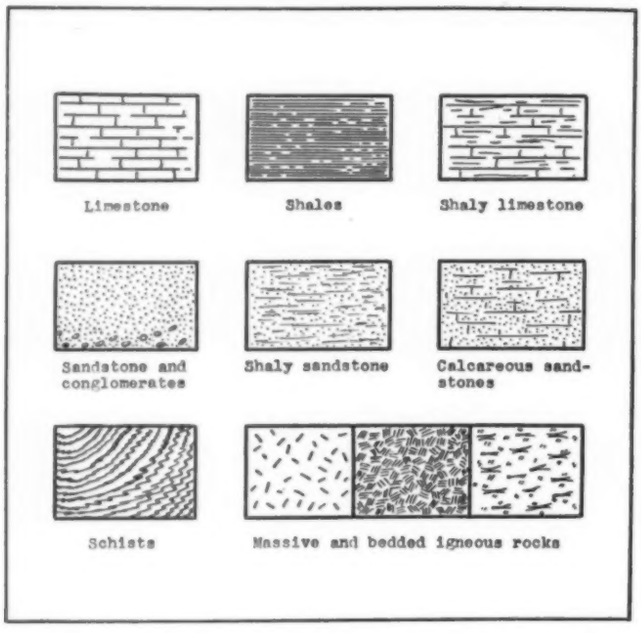


Fig. 11—Conventional Symbols for Kinds of Rocks. (From "Building Stones and Clays," by E. C. Eckle).

ing can be completed within a reasonable time and no delay will be experienced in completing the final and detailed report.

The final report consists, in the main, of seven parts and is the summary of the conditions and materials as found along the route to be surfaced. The report includes the following items:

1. Title sheet
2. Summary sheet
3. Detailed description of each location from which samples were collected
4. Sketch showing the plan and elevation of each material site
5. Photograph of each material site
6. Official report of the testing laboratory on each sample submitted
7. Map of the route covered, showing the approximate location from which each sample was collected.

A typical summary sheet referred to in the preceding outline is illustrated in Table IV. This summary is useful in that it shows immediately the results of the survey over a given project. Table V gives a typical detailed description of a rock location. It should be noted that the information given in this table is more complete, in some respects, than that given in the summary sheet. Figure 10 is a sketch showing the plan and elevation of the location from which a sample of rock had been collected. A sketch of this kind is made for each material site. Usually a few notes applicable to the site, such as quantity of material available, amount of overburden, etc., are also shown on the sketch. The conventional symbols for different kinds of material, used in preparing these sketches to accompany the material survey reports, are shown in Figure 11.

▼

HIGHWAYS IN UNION OF SOUTH AFRICA—In 1931 the total highway mileage in the Union of South Africa was 111,236, consisting of 750 miles of hard-surfaced roads, 27,500 of graded and drained main roads, and 82,968 of unimproved earth or veldt roads, passable only in the dry season. A total of 186,073 motor vehicles was registered on Jan. 1931.

Work of Philadelphia Technical Service Committee

To meet the problems brought about by the continued lethargy of business, as it affected the professional technical worker then and now unemployed, "The Engineers' Club of Philadelphia," in January of this year, sponsored the Philadelphia Technical Service Council. This group consists of representatives from twelve national Engineering Societies, and the association of the State Employment Commission of Pennsylvania has been secured. Thus all requests for technical men are handled through the committee for the Philadelphia Metropolitan area.

The work of the committee, consisting at present of six office workers and fifteen field callers, is divided into four main divisions: Placement, field contacts, publicity, research. The primary object is to secure placement for the registrant, at the same time securing for the employer the best talent available. Since volunteers from among the registrants do the work, this valuable aid to industry is available to employer and employe alike, without charge.

The following analysis of the 1,005 applications on file to and including Aug. 27, 1932, give some interesting statistics on the unemployed engineer:

Architectural	17	Mining and Metallurgical	21
Chemical	103	Mechanical	368
Civil	230	Structural	49
Electrical	191	Miscellaneous	15
Industrial	11		

Results in the efforts to place men have been satisfactory under the prevailing conditions, and a statement of this part of the work of the committee follows. Information is as of July 31.

In the examination of 135 cases for relief, 30 of the urgent cases were given remunerative work on a 5-day basis, directly negotiated for and sponsored by the "P. T. S. C.":

	Total firms applying.	Total requests.	Applicants referred, total.	Placements reported, total.
Salary jobs—local	62			
Out of town	25			
	87	164	383	82
Commission jobs—local	42			
Out of town	1			
	43	99	121	12
Made work	0	30	30	30
Combined totals	130	293	534	124

▼

U. S. Tests Grasses for Airport Fields

To find the best grasses or other plants, for planting on air plane landing fields, the United States Department of Agriculture has planted 34 different grasses and combinations of grasses on an acre test plot of the Washington-Hoover Airport field near Washington, D. C.

The experiment is the first of its kind made by the department. The department expects to find some of the plants suitable for covering landing-field areas except the actual runways. The test plot is at one side of the present field, but next year the field will be enlarged and the test grasses will be near the center of the field, where the effect of landing and departing planes may be observed.

The department receives many requests for information and aid on growing grass for airports. Some of the chief reasons for planting grass on landing fields are to avoid dust, mud, standing pools of water after rains, and washing away of the soil.

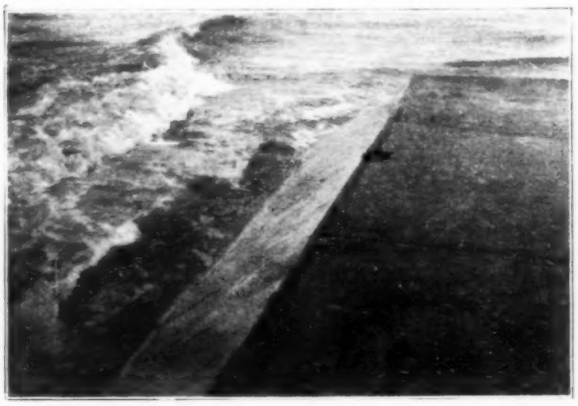
Concealed *Sea Wall* Protection

Bridge Approach and Highway to Beach Saved from Destruction

By W. G. Gibson
County Engineer, *Lee County, Fort Myers, Fla.*

UP until 1928, the people of Fort Myers, Lee County, Florida, the adjoining counties and the hundreds of visiting tourists, both summer and winter, had to cross a very dangerous pass on a dilapidated wooden draw bridge in order to reach the beautiful beach on the Gulf of Mexico, where swimming is enjoyed the year 'round. At this time, the Board of County Commissioners sold enough bonds to build a concrete bridge with a six hundred (600) foot concrete approach on the bay side and a sixteen hundred (1600) foot concrete approach on the gulf side of the pass. With money available it was easy enough to make these improvements, but the main problem was how to protect the gulf approach from heavy tides and hurricanes. The accompanying photographs, which were taken during construction, at high tide, and after a hurricane of light wind velocity but heavy tides, will show the solution of the problem.

A Good Idea of What Would Have Happened to the Approach at the Bridge Proper Had It Not Been Protected. Note Debris Left in Wake of Storm

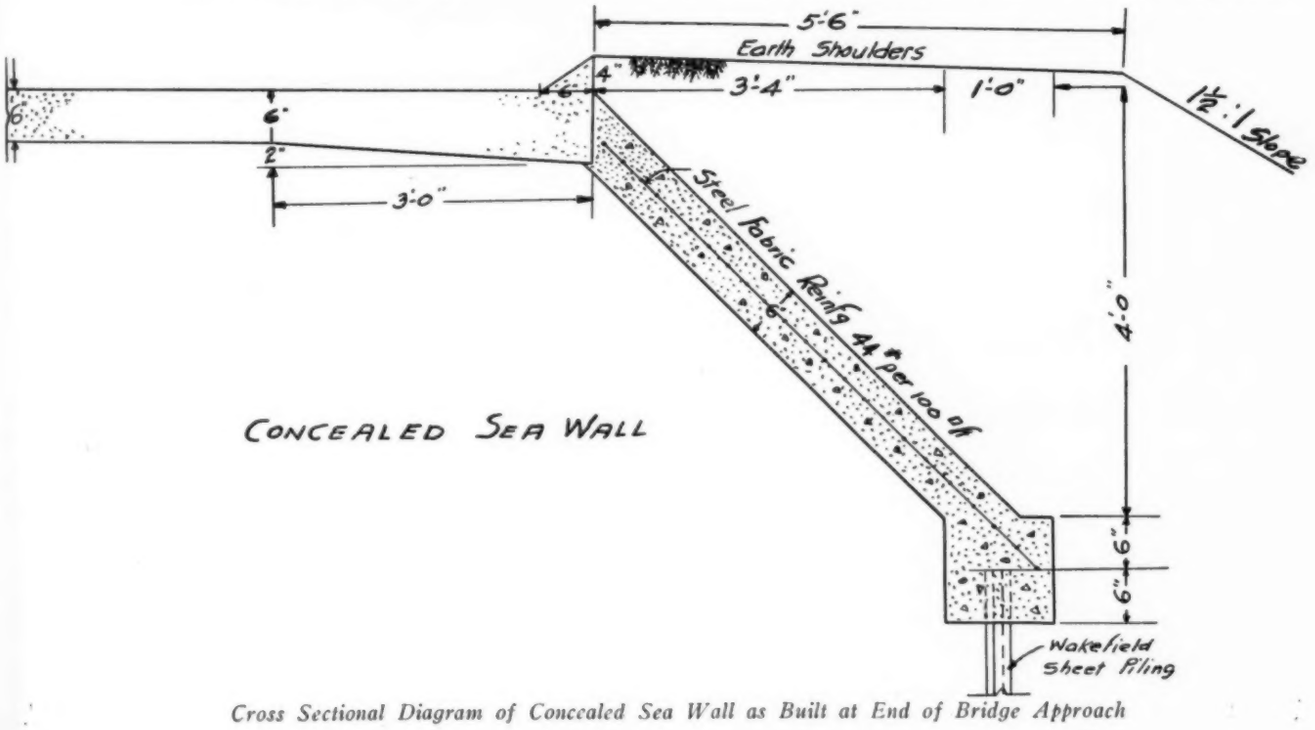


How the End of the Approach is Standing the Fury of the Waves From the Gulf

This wall consisted of a concealed six (6) inch concrete slab constructed along and below the edge of the pavement. It inclined downward at an angle of approximately forty-five degrees from the edge of the pavement and rested upon sheet piling.

The sheet piling consisted of sound dressed lumber, of quality of eighty (80) per cent, or better, heartwood so constructed as to form Wakefield sheeting of thickness of (3) inches for lengths of not less than six (6) feet.

The Wakefield piling was constructed first by removing the earth from the trench and jetting the piling to the required elevation. The approach or highway was next constructed and then the wall proper was constructed by placing concrete in the trench around and over the sheet piling and extending up the slope of the excavation to intersect and connect with the edge of the



Cross Sectional Diagram of Concealed Sea Wall as Built at End of Bridge Approach

pavement slope. Steel fabric of forty-four (44) pounds per one hundred (100) square feet was used as reinforcement and placed in the concrete equally distant from each edge. The back slope of the excavation was used as the underform and by securing a mix with a slump of not more than three (3) inches, the face of the wall was extended up the slope without the necessity of using face forms.

Mr. J. A. Long, who was county engineer at the time, but now with the Florida State Road Department, was the designer of the wall, and the writer was the project engineer in charge of construction.

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Experimental *Resurfacing* Old Pavement

By T. H. CUTLER

Chief Engineer, Missouri State Highway Commission

DURING 1930 the Missouri Highway Department built a 2-mile section of experimental resurfacing running south from the city of Joplin, on U. S. 71. In 1931 another pavement, lying between Joplin and the Kansas state line, was resurfaced with several types of asphalt or with various designs of concrete as a further experiment.

This newest experimental section is nearly 4 miles long. The old pavement was built in 1921-2 by the Joplin Special Road District's own forces. It was 18 feet wide, had a 6-inch edge and 8-inch center thickness, and was built with chatts and rolled flint sand proportioned—1:2:4. Wooden forms were used in its construction and it was finished by hand, which caused it to have a very rough, irregular surface.

The resurfaced pavement lies between Joplin and the mining fields of Kansas and Oklahoma. Joplin is the trading center of this region and mine machinery and other supplies are carried by truck from Joplin to the mines. Many truck loads of such supplies were hauled over the old pavement, which was heavily traveled, as indicated by a 1928 traffic count that showed an average of 5,812 vehicles using the road daily. This heavy traffic had broken the thin-edged pavement badly, so, when maintenance of the road was taken over by the State Highway Department, it was decided to resurface 4 miles of it with various materials as an experimental project.

The roadway was regraded to a total width of 36 feet by the maintenance forces and contracts were let for furnishing the various types of resurfacing materials. It was planned to widen the pavement to 20 feet by the addition of concrete curbs one foot wide along each edge of the old slab. On the asphaltic sections these curbs served to retain the surfacing material; on the concrete they were built as a monolithic part of the resurfacing slab. Half of the total project was surfaced with various designs of concrete slab and the balance with several different asphaltic preparations.

Cross section levels were taken at 10-foot intervals on the surface of the old pavement and a grade line was established that would give a minimum thickness of 4 inches for the concrete resurfacing. The average thickness was 5½ inches.

For the asphaltic sections a filler course of Precote was used to bring the surface up to the level required for the wearing course. The wearing course was from 2 to 2½ inches thick. In one section it was Bit-U-Crete, in another what is known locally as Flint Mix, a third was Precote and the other 5 were rock asphalts from various sources.

The portion resurfaced with concrete was divided into 17 sections which were of the same width and thickness but were differently reinforced, had a different arrangement of tie bars across the center joint, of dowel bars across transverse joints or some other variable.

Three sections were constructed with a layer of paper separating a wearing course from a base course used to eliminate inequalities in the old pavement. In the first of these 1:2:3½ concrete was used as the base. It was placed on the old slab and immediately struck off 4 inches below and parallel to the finished surface. The prepared paper separator was laid on this struck-off concrete and the pavement was placed over it. This method of installing the paper separation plane proved very unsatisfactory and did not give the desired results. The coarse aggregate in the base course made it impossible to strike off a layer less than 2 inches thick and it was difficult to keep the paper separator horizontal while concrete was being placed. Instead it became wavy and in some places was torn.

On another section a base course of 1:3 mortar was used to smooth up the old pavement and the paper separator was laid on top of this struck-off layer. This method gave much better results than the one described above. The concrete in the surface layer was 4½ inches thick.

The third section of this sort had a base course of 1:2 mortar that was struck off 4½ inches below the surface of the finished slab. The base course was straight-edged and finished with metal floats, to secure a smooth surface, and was allowed to stand 2½ days before the paper separator and the balance of the concrete were placed. This gave a firm base on which to place the paper and was much more satisfactory than either of the other methods.

On all the concrete sections 1-inch pre-molded expansion joints were spaced at 80-foot intervals, with contraction joints midway between them. A longitudinal plane of weakness was cut along the center line and filled with ½ by 1½-inch pre-molded joint material.

In general, dowels were placed across contraction joints. These were ½-inch round bars 30 inches long and were greased but not provided with a sleeve. Dowels of the same size were used across most transverse expansion joints but one end was covered by a metal sleeve to provide slippage and allow space for closure of the joint. Slabs were tied together across the center joint by ½-inch round deformed bars 4 feet long. In general, these were spaced 5 feet apart. On some sections a ¾-inch round bar 41 feet long was placed along the edge of the slab, projecting 1½ feet across the transverse joint. This end was covered by a metal sleeve which permitted closing of the joint without buckling the bar.

No special loads will be run over the experimental sections. Instead they will be allowed to carry the regular heavy traffic that uses this particular highway. The maintenance department will keep a record of the repairs required by each section and periodical inspections will be made to determine and record the condition of each. In that way this experimental road and the one built last year will serve as a guide in designing future resurfacing.

Mistaken
RAILWAY ARGUMENTS
Against Highway "Carriers"

Ratio of Bond Capitalization to Total Capital Out of Balance in Railroad Financing

THE Committee on Public Relations of the Eastern Railroads says in its Yearbook of Railroad Information, 1932 Edition:

"The railroads are not unique in their record of reduced business and lowered earnings. But the seriousness of their present plight and the practical destruction of their credit are not due solely to national depression. They are also due to public policies, states and national, which not only permit but encourage unfair competition with railroads—policies which just require the railroads to pay all of their own costs, but which freely grant subsidies from public funds to carriers by water, by highway and by air; and policies which strictly regulate railroad operation 'in the public interest' but which permit, broadly speaking, practically unregulated operation of the railways' competitors. These unjust and inequitable public policies are the real basis of the present railroad problem."

In effect railway officials say that if motor-busses and trucks were required to pay taxes high enough to cover their share of interest and maintenance costs of the highway, then the competition between those carriers and the railways would be fair. They have overlooked two facts: first, that highway carriers are paying very large tolls in the form of taxes; and, second, that the tolls thus levied on all motor-vehicles pay interest and maintenance costs on all existing road improvements.

Inclusive of the 1 ct. federal tax and the average 3 ct. tax per gallon of gasoline, and the license fees, these tolls now total a billion dollars annually. Railway officials do not charge that these highway tolls are levied inequitably. All they do is completely to ignore their existence. In 1930, which was the year of maximum railway taxes, those taxes fell just short of half a billion dollars. That this is an unjustly high tax we do not doubt, but it is only about half as high as the present tax on the owners of highway vehicles.

The serious financial troubles of our railway began long before highway competition was in the least bit serious. Those troubles date back 26 years, to the passage of the bill that "put teeth into" the federal law that controls the railroads. Not long afterward nearly every state passed a similar law with similar "teeth," and the "teeth" began to bite. They had chewed most of the profit out of the railway business long prior to the advent of the alleged unfair highway competition against which railway executives now inveigh. For more than a generation the typical American railway has barely earned a bond interest rate on the value of its plant. Such a condition was fatal to railway prosperity. Only within the last decade has highway competition cut appreciably into railway traffic, and then only as to passenger transportation. In the 8 years ending in 1929, railway passenger-miles per capita declined 26 per cent, and that was due more to privately owned motor-cars than to public busses. During the same period there was no decline in railway ton-miles per capita. These figures are taken from the railway yearbook mentioned above. They serve to refute the charge that unregulated competition is the basic cause of railway troubles. If highway carriers were regulated as are railway carriers, still would the latter remain striken with poverty. The loss of the 26 per cent of passenger traffic above mentioned means only 6 per cent loss of gross income. It is not that loss that has turned investors away from the railways. It is the unremunerative rates on freight and high taxes that account for low net earnings. Also there should be considered the federal law that limits annual net earnings to 6 per cent of railway value, as a dead line beyond which no railway can pass without having half its excess earnings. confiscated. Because of inadequate earnings this law has seldom been brought into action against a railway, but like a menacing gun it has scared away investors. This law is not regulatory. It is confiscatory, for it prescribes less than a market rate on capital invested in business enterprises. So long as capital can find other realms that are not ruled by such a bolshevistic law, capital will avoid the railways. That capital has thus avoided them is evident from the fact that 77 per cent of the money raised by the sale of new railway securities during the last decade has come from the sale of bonds. When any company raises more than half its capital by sale of bonds, it is either poorly managed or is forced to do so by conditions beyond its control. Railway companies fall in the latter class.

We trust that railway executives will cease their efforts to fasten upon highway "carriers" the chains of government regulation. They will fare better if they fight for greater freedom and for freight rates that yield a profit sufficient to attract capital.

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Another Curiosity of Figures

$$1 \times 8 + 1 = 9$$
$$12 \times 8 + 2 = 98$$
$$123 \times 8 + 3 = 987$$
$$1234 \times 8 + 4 = 9876$$
$$12345 \times 8 + 5 = 98765$$
$$123456 \times 8 + 6 = 987654$$
$$1234567 \times 8 + 7 = 9876543$$
$$12345678 \times 8 + 8 = 98765432$$
$$123456789 \times 8 + 9 = 987654321$$

Henry Sparks, Clerk, Union Township, Fayette County, Ohio.

An Open Letter to the Reconstruction Finance Corporation

THE daily papers tell us that a committee of Illinois state and city officials is about to go to Washington to try to secure money for relief of the unemployed, pending the passing of a state relief bill. The proposed bill provides that any county may either divert its share of the state gasoline tax from roadwork to unemployment relief, or enact a general sales tax for such relief.

The diversion of gasoline taxes not only will increase unemployment but will put the Illinois policy of relief in opposition to the federal policy of relief. The federal government increased its normal appropriations for roadwork with the purpose of reducing unemployment. Hence any state that diverts its gasoline taxes is doing its share toward vitiating the federal policy of creating jobs.

Under your direction one and a half billion dollars may be loaned for self-liquidating projects, other than those dependent upon taxation for repayment of the loans. Were it not for this last provision of the law, state roads would come under the classification of self-liquidating projects; for the gasoline taxes are designedly tolls raised for the purpose of building and maintaining roads.

In an economic sense our rural roads are as truly self-supporting as our publicly owned waterworks. About 11 billion dollars is the estimated cost of reproducing our 3 million miles of rural roads. Including the 1 cent federal tax the average tax on gasoline is 4.5 cents. Based on last year's consumption of gasoline, this 4.5 cent tax would total nearly $700,000,000. The annual registration fees of motor vehicles total $350,000,000, and they likewise constitute a charge for the use of the highways. Hence the total charge for such use exceeds a billion dollars. Against this revenue there is an annual expense of about $450,000,000 for road maintenance and repairs, leaving more than $550,000,000 for interest and amortization, on the 2 billion dollars of road bonds, and for improving the roads. The $550,000,000 is 5 per cent of the 11 billions invested in roads. Hence, our roads are more nearly self-supporting than our railroads.

There are 26 million motor vehicles whose average retail price was about $700.00 each, making a total of 18 billions of dollars invested in them. City streets represent a total cost of about 5 billions. Garages, etc., add another 4 billions. Hence the highway industry represents an investment of about 38 billions which corresponds to a 27 billion dollar investment in railways and their rolling stock.

During the 15 years ending in 1928, the number of motor vehicles increased 19 fold, or 1900 per cent, whereas railway rolling stock showed only 12 per cent increase. During those 15 years the mileage of "surfaced roads" barely doubled, which shows that highway improvement fell far short of the increase in motor vehicles.

The congestion of traffic on suburban roads on Saturdays and Sundays is usually so great as to deprive motorists of much of the pleasure of motoring. This is occular proof that highway improvement has lagged badly behind the requirements.

It has been said repeatedly by economists that the crying need of America is another new industry comparable to the highway industry, including motor vehicles. Only by thus creating new jobs will America escape the dole system of Great Britain. Those who advocate diversion of road tolls, to wit gasoline taxes, seem not to realize that they are advocating the dole system. If they reply that the diversion of the gasoline tax is justifiable because it will be only temporary, let me ask them whether they would thus justify discharging city waterworks maintenance and improvement gangs.

The leaders of both great political parties have favored increasing construction, both public and private, as a means of reducing unemployment. They have differed only as to the extent that the federal government should go. I doubt whether certain state and city politicians realize that they array themselves against the policies of national political leaders when they advocate diversion of gasoline taxes and the resulting discharge of men engaged in repairing and improving highways.

Automobile clubs have invariably expressed disapproval of proposed diversions of gasoline taxes. They voice the sentiment of all motorists, and therefore of practically all the voters.

In view of these facts, you will be justified in refusing a loan to Illinois unless a pledge is made that gasoline taxes will not be diverted from road maintenance and improvement.

HALBERT P. GILLETTE,
EDITOR OF ROADS AND STREETS.

Chicago, Ill., Sept. 21, 1932.

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Favorable Comment

A fine editorial in the August issue of ENGINEERING AND CONTRACTING contains sound criticism of some of the objectionable rules restricting the use of machinery on the Federal Aid Emergency Projects. In that editorial it is pointed out that the Emergency Relief and Construction Act authorizes the Secretary of Agriculture to make rules and regulations with a view to providing the maximum of employment of local labor consistent with reasonable economy of construction, and and that this provision has been construed to mean the employment of hand labor instead of machinery where it can be done without greatly increasing the cost of the work. Question is raised as to whether this was the intent of the Act, and the conversion of highway funds into charity funds is deplored.

With the Bureau of Public Roads on record to the effect that under normal methods of highway construction 91 cents of the highway dollar goes to labor directly or indirectly, it is difficult to understand how much additional economic benefit to labor can be derived from the restrictive provisions of law and of the rules and regulations that have been made applicable to this Emergency Work. Apparently the most that can be hoped for is to spread the expenditure among a greater number, in thinner amounts per worker, and under conditions that discriminate against the skilled worker in favor of the unskilled.—*The Nerba, Official Organ of the New England Road Builders' Association.*

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Will Rogers says—

Both political parties are trying to help the railroads. The railroads could help themselves if they would make the fares what they were in the days when they used to make money. If they would compete with a bus and truck instead of just cussing 'em they wouldn't need all this help.

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AMERICAN ASSOCIATION OF STATE AND HIGHWAY OFFICIALS.—The annual meeting of the American Association of State Highway Officials will be held in Washington, D. C., from November 14 to 18, 1932, inclusive. W. C. Markham, Executive Secretary, National Press Building, Washington, D. C.

. . . EDITORIALS . . .

Some Objectionable Rules Restricting Use of Machinery on Federal-Aid Roads

THE Bureau of Public Roads has published rules under which each state must act if it is to receive any part of the $120,000,000 federal-aid emergency appropriation for highways. The rules will be found in the September issue of ROADS AND STREETS. Although these rules do not apply to the regular federal-aid appropriation of $125,000,000 for the ensuing fiscal year, they relate to such a volume of proposed road work that their economic importance is great.

All funds provided by the $120,000,000 emergency appropriation must be expended prior to July 1, 1933. Hence contracts are now being let. Probably it was the urgency of the case that led to the formulation of the rules restricting the use of machinery prior to consultation with state highway authorities. It is not unlikely that such a conference is planned, with a view to revising these rules which may be regarded only as tentative. We urge a revision in the interest not only of economy of public funds but in order to avoid converting state highway departments into charity dispensaries.

The "Emergency Relief and Construction Act of 1932" appropriates $120,000,000 as an emergency federal-aid to states in building roads during the ensuing year. The object is to reduce unemployment. The act prescribes that "The Secretary of Agriculture and the Secretary of the Interior, respectively, are authorized to make rules and regulations for carrying out the foregoing provisions of this section with a view to providing the maximum of employment of local labor consistent with reasonable economy of construction." This provision of the act was construed to mean that hand-labor should be used instead of machinery wherever this could be done without greatly increasing the total cost of a given road. We doubt whether this was the intent of the act. It seems to us that the emphasis should be placed on the word "local." The object was to provide as much work as possible for local labor in each of the states. This is accomplished, for example, where no great percentage of materials, such as broken-stone, is imported from places far removed from the district in which the road work is being done. But to prescribe that in a road-side quarry or pit the rock or gravel must be conveyed to the crusher by hand or by teams seems to us not to lie within the provisions of the act, because the act prescribes "reasonable economy." It is usually unreasonably expensive to transport rock or gravel in a quarry or pit by hand or by team.

A study of all the restrictive rules shows that their authors had in mind that while hand-labor may be excessively expensive for the particular operations to which it relates, all the restricted operations put together would not total a very large percentage of the cost of the average state road. In the case of a concrete road, the restrictive rules as to the machinery are such as not to increase the total cost but a few per cent. But in the case of a gravel road, where "road-side pits" are used, the percentage of increase in cost as a result of the specified use of hand-labor may be unreasonably excessive. Instances like this indicate the desirability of so modifying the rules as to give greater latitude to the state highway engineers in charge of the work. Such latitude can be given, and as a matter of fact, one of the important rules is not mandatory but permissive.

Although the expression "reasonable economy of construction" lacks definiteness, still there are criteria of economic reasonableness by which engineers are usually guided, and these criteria should be applied. If a unit-cost under given conditions is within 10 per cent of the average cost under the given conditions, under intelligent supervision, it would usually not be regarded as unreasonably uneconomic. Even 15 per cent excess of normal unit-cost may not be unreasonable. But certain rules under discussion will incur unit-costs several hundred per cent in excess of normal costs. Take, for example, the rule that the spreading of earth in fills shall be done by hand, or the rule that the initial spreading of broken-stone for macadam shall be done by hand.

About 30 years ago the editor introduced the use of a small blade-grader for spreading macadam. The previous unit-cost of such spreading, even with very low wages had been 12 cts. per cu. yd., and it was reduced to 2 cts. per cu. yd. by using a grader hauled by a team. (See Gillette's "Handbook of Cost Data," p. 270). The 12 cts. is 500 per cent greater than the 2 cts. There can be no question as to the unreasonableness of such a difference in cost. The grader method of spreading stone has been superseded in many cases by an even better method. Where stone is delivered in motor-trucks a leveling device may be attached to the rear of the truck and it spreads the stone automatically as fast as it is discharged from the truck which is kept moving as it unloads. Literally interpreted, the rule prescribing hand-spreading would prohibit the use of such a mechanical spreading device, and it would add several thousand per cent to the unit-cost of spreading. Can there be any doubt that this rule violates the act which prescribes "reasonable economy"?

Not long ago Thomas H. MacDonald, Chief of the Bureau of Public Roads, testified before a senate committee that labor gets about 90 per cent of the price received by a contractor for building a road. Of course this includes the labor involved in manufacturing and transporting materials and equipment. It follows that labor has little to gain, while the public has much to lose, if restrictions are placed upon the use of machinery in road building. Suppose, for example that concrete-mixers were excluded (and one of the Bureau's rules does exclude them, in making small head-walls), there would be very little added to the pay envelopes of the concrete mixing gangs, but the taxpayer would receive considerably fewer square yards of concrete pavement for his money. "Local labor" would receive very little additional employment as a result of prohibiting the use of concrete mixers, for the number of skilled workers employed in operating concrete mixers is very few. Moreover, are not those few skilled workers entitled to a job as well as the many unskilled workers?

Since only 20 per cent of our total road mileage is classed as "surfaced," and since most of those "surfaced roads" have a width of paved or dressed surface that is too narrow for safety, it is evident that public funds can nowhere be expended to better advantage than in road improvement. Automobile users—and they con-

stitute most of the public—have been, and are, strong advocates of continued road improvement on a large scale. Let us do nothing to change this attitude. We fear that any attempt to convert highway funds into charity funds would have the same effect as permitting pork-barrelism to permeate this field of public works. Prohibiting the use of machines that reduce the unit-cost of roadwork will inevitably lower the respect in which the public now holds the highway departments of our states. Nor will the claim that charity justifies an increased unit-cost strike many voters as being sound.

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The Merit of Bond Issues for Public Works and Unemployment Relief

ABOUT a billion dollars in cash remain in hiding, hoarded by people who became fearful of losing their savings through bank failures. Each dollar of this money, if redeposited, would support five dollars of bank credits. Most of it can be brought back into circulation by issuing public bonds of small denomination.

The total volume of public works is considerably below normal. Even when normal it lagged behind the economic needs of the country. Hence public bond issues at present will serve a double purpose: Such bonds will put into circulation a vast sum of money that will otherwise remain dormant for a year or more; and the money thus raised will give employment.

Local or state taxes for the relief of unemployment may be necessary, but they add nothing to the volume of money in circulation. Such taxes merely take money from those that have and give it to those that have not. They arouse no feeling of good will either on the part of the taxpayer or on the part of the recipient of the charity. Doles are objectionable from every point of view. Public bond issues are objectionable only from one point of view, but the objection is largely offset by the fact that they will bring hoarded money into circulation.

Unemployed people must be fed. The choice of methods of raising money by which most of them are to secure food is narrowed down to two: Either by current taxes or by bonds. Current taxes are almost unbearable. Hence they are not likely to be increased much. Future taxes, as a result of bond issues, will have the merit of falling upon us when our earnings are normal, which means when they are about 50 per cent higher than at present.

The interest on bonds issued now for public works and for direct relief of the needy can be provided for by a small sales tax on commodities in general. What taxpayer would not prefer to pay 5 per cent annual interest on emergency relief bonds to paying a tax equivalent to the entire value of the bonds?

The diversion of gasoline taxes from road maintenance and construction merely serves to add thousands of men to the unemployment lists. The same is true of any plan of reducing public expenses where that plan involves either discharging employes or ceasing to purchase equipment, materials or supplies in normal amounts.

Too many people see no difference between public economics and private economies. If a private firm at present discharges an employe it relieves its own burdens only by throwing them upon the shoulders of the public. This may be, and usually is, an unavoidable act. But when the public discharges employes—and it does just this when it diverts the gasoline tax—it does not throw the burden of their support upon other shoulders. It merely substitutes doles for wages. If it be argued that there is public saving anyway, because the wages are too high, let the wage question be decided upon its own merits; but let no one be deceived by the general clamor for reduced public expenses. Public expenses have got to be higher than normal so long as private employment is grossly subnormal; for the employed public will not let the idle starve.

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Let the Four Types of Transportation Compete Freely

THE Chicago Tribune advocates releasing railroads from "the stranglehold of government regulation." It believes that they should be permitted to compete freely among themselves and with motor trucks and buses. We quote from The Tribune:

"Both railroad and motor vehicles are needed for the maximum convenience and economy of transport. Motor transport is going to feel the effect of the tendency to utilize gasoline taxes for emergency relief, but that, we trust, is a transitory factor. In normal conditions public policy requires a fair impost for the use of the roads adjusted to the wear and tear involved in heavier types of vehicles and to other factors. It requires regulation in the interest of safety and convenience of the general public. But we do not favor submitting motor transport to an elaborate system of rate regulation such as has played havoc with the railroads. Sound public policy will not drag motor transport down in order to equalize it with the railroads. On the contrary, the railroads should be released from the stranglehold of government regulation and be permitted to compete freely and to develop their resources to the full so long as this development is consistent with the public's interest in the maximum efficiency of transport facilities. The railroads should be permitted to give up obsolete services or to use motor transport as an auxiliary wherever it is more economical and efficient than rail lines and equipment. In short, public policy calls for the removal of unwise restraints, not their application to the new facilities. Its proper objective is the fullest development of all modern facilities of transportation compatible with economy and efficiency."

It was because the public regarded railways as monopolies that laws were enacted to regulate their freight and passenger rates. The monopoly feature never was serious, and it has become rapidly less important during the past decade. Alarmed by present and prospective competition with highway transport, many railway executives are publishing propaganda whose object is to reduce such competition by placing all public carriers on highways under the regulatory control of railway commissions.

In Great Britain the same effort has met with some initial success, for a committee headed by Sir Arthur Satter has reported in favor of increased taxation of commercial motor vehicles and "prohibition of unsuitable traffic on the roads."

When stage coaches were introduced from France into England, the boatmen of the Thames and other rivers tried to induce Parliament to prohibit the operation of public coaches. When steam railways were invented, the stage coach owners did all that they could to hamper the development of rail transportation. Now we see the railways striving to hamstring motor trucks and buses.

We have experimented with railway regulation for

50 years, and during the last half of this period the regulation has become progressively more strict. Can we point with pride to the result? Quite the contrary.

It would seem wise to try the experiment of reverting to the old American policy of permitting free competition to regulate the rates of all our common carriers. We now have four distinct types of transportation: (1) By water, (2) by air, (3) by rail, and (4) by road. There is nothing to fear from transportation monopoly. There is more to fear from governmental repression through regulation.

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Brisbane Ridicules Hand Work on Highways

IN his editorial column in the Hearst papers Brisbane recently told of seeing a gang of 50 men pulling weeds along a highway. He said:

"Their work and their time are wasted; they know it. The whole thing is a mockery, telling them to go out, wasting oil and gasoline in their automobiles, and squander their time on wasted labor."

With some machine, like a grader or a weed cutter, the work of these 50 men could have been done. Only slightly less wasteful is the hand-labor specified in some of the rules under which the $120,000,000 of emergency relief money is to be spent, as indicated in the September issue of ROADS AND STREETS. Unless highway work is to become the butt of universal ridicule, those rules should be drastically revised.

Brisbane closes his comments on the highway weed pullers, thus:

"And that is the best that American intelligence can find for idle men to do. That is how our competent welfare gentlemen waste the time of workers, and spend money that might be used to produce something worth while. If any intelligent European could see this United States 'welfare work' he would think himself in an insane asylum, not among so-called intelligent people."

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Inequitable Federal Taxes on Motor-Vehicle Owners

AMONG the 27 excise or sales taxes levied by the last congress, six were upon the owners of motor-vehicles. The estimated annual taxes from these six kinds of sales were:

Gasoline	$150,000,000
Lubricating oil	33,000,000
Tires and tubes	33,000,000
Passenger cars	32,000,000
Trucks	3,000,000
Parts and accessories	7,000,000
Total	$262,000,000

Practically all of the federal gasoline tax of 1ct. per gallon is paid by owners of motor vehicles. Since most of the lubricating oil tax is similarly paid, it is safe to say that congress expected to add $250,000,000 to the state license fees and gasoline taxes that total $900,000,000.

State gasoline taxes average about 3.5 cts. per gallon. The federal government should not have imposed the additional 1 ct. tax, for gasoline taxes were originated as tolls for the use of the highways, and have been used for highway maintenance and improvement.

Congress should have passed a general sales tax on all manufactured products, instead of burdening a few products with heavy excise taxes. This may be done at the next session, for the actual revenue from the excise taxes is running 60 per cent below the estimated revenue. For example, only one-third as many automobiles were sold in July as in a normal month; the nuisance tax on bank checks totaled little more than half what was expected; and the tax on matches yielded only one-sixth the anticipated yield.

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The British Plan for Throttling Highway Transportation

SOME of the American owners of motor trucks and buses favor federal and state regulation of their business. At a recent convention of the National Association of Motor Bus Operators the president of the association, Arthur M. Hill, said: "Our members are regulated by all the states except Maryland." But they haven't seen anything yet in the way of regulation, according to Charles Brand, representative from Ohio, who said:

"Former President Coolidge is the most dangerous man in the country today for your interests. He will give you what you want, which is federal regulation to the degree that it has developed for the railroads. The railroads are being strangled to death, and you bus operators will be strangled with them."

Mr. Brand referred to the nonpartisan railroad commission of which Mr. Coolidge has been named chairman. Other members include Bernard M. Baruch, Clark Howell, Alexander Legge, and Alfred E. Smith.

"The federal regulation of bus and truck rates and the higher automobile tax charges advocated by the railroads, or anybody else, are indefensible," he declared.

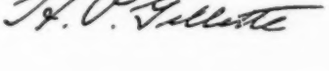
Mr. Brand might well have cited what has recently happened in Great Britain, where, in an effort to protect the railways, commercial vehicles are about to be taxed so heavily that: "British truck operators claim that the proposed taxation recommended by the conference on road and rail transport will drive trade off the roads."

As an example, 5 to 7 ton steam-driven trucks, which have hitherto been taxed about $240 a year will be taxed about $940 if the recommended taxes are adopted by parliament. Gasoline-driven trucks are taxed somewhat less because there is a tax of 6 cts. per gallon on gasoline.

License rates in Great Britain are already enormous. A private motor car pays nearly $5 per horsepower! This partly explains why there are only a million private automobiles in all of Great Britain. Possibly railway influence in parliament accounts for such taxation.

In this connection it is well to remember that intrenched interests in Britain have successfully blocked the natural development of the electric light and power industry since its birth. It was feared that the illuminating gas industry, which was largely owned by cities, would be ruined by the electric light industry, so the latter was never allowed to develop freely as in America. The same sort of repression is being applied to the motor vehicle industry in Great Britain. The British have always been noted for "conservatism," even to the point of repression, so they are merely running true to form.

There are some Americans who prefer industrial freedom to industrial repression. It might be well to let Great Britain continue to be the great object lesson in repression, and let America exemplify freedom.



Tolls With Taxes

BRIDGE construction projects of a self-liquidating nature are not confined to large bridges. A program including many smaller bridges on which a toll gate can be temporarily built may easily amount in dollars and cents expenditure to that of a large project.

Now is the time to build those bridges which the various states, counties, townships, cities, and towns have been postponing for lack of funds. Funds of the Reconstruction Finance Corporation are available provided that a portion of the cost is financed by collection of tolls. Tax money may also be used in conjunction with tolls provided that the law by which the taxes are collected was enacted prior to the passage of the relief act by Congress. The actual wording of the rules governing loans by the R. F. C. for these projects is as follows:

"Loans may be made to aid in financing the construction of any publicly owned bridge to be used for railroad, railway, and highway uses, the construction cost of which will be returned in part by means of tolls, fees, rents, or other charges, and the remainder by means of taxes imposed pursuant to State law enacted before July 21, 1932 (the date of enactment of the Emergency Relief and Construction Act. of 1932)."

At this time perhaps it would be well to suggest that bridge engineers in making up their programs consider the economic advantages of short span suspension bridges. The suspension bridge is appealing to the eye and can be built, justifiably, in span lengths as short as 150 feet. Standardized spans, if not now obtainable, should be made so and should be so designed that extensions may be added or parts removed to make the standardized span fit the location.

A program of varied types of construction of smaller span bridges, will materially aid in spreading employment. Consider the possibilities afforded by the clause (quoted above) in the rules governing loans by the R. F. C. Build now!

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Annual Cost of a House and a Highway

LET us be seated for a moment of sober reflection on our highway programs. Let us sit still and think, without interruption, or without influence of either biased or unbiased propaganda, about what we are doing in the way of building highways and whether or not we are doing the right thing. We must divorce our minds of the propaganda of high taxes, of excessive cost of government, and such matters, and compare expenditures from our own family income with expenditures for road work.

As manager of the family budget you have, at some time, been confronted with the question of whether you should continue to send the family washing to the steam laundry or buy a washing machine and do the work at home. You will do the one that saves you money or that is less costly, in the end, to you. You calculate such saving as a definite return or dividend on your action. After a certain period of time you consider that the saving would amount to sufficient to purchase a new garment and you feel justified in making the expenditure. The same reasoning is applied to furnace regulating attachments and to insulation for a house. You buy storm windows because you are convinced that they pay for themselves due to the saving in coal their use effects.

Exactly this same reasoning applies to funds expended for road work. These expenditures improve the road surface, making it possible for you to operate your car at less expense over the improved road than over the poorer road surface. Knowing this you feel entirely justified, even enthusiastic, in spending public funds for this type of improvement. You wonder, perhaps, how much a road costs.

Only too often is the annual cost of a road misunderstood. The original investment and the annual cost are two different things. When you purchased your house you figured out how much it would cost you per month or per year. You were not interested, particularly, in the total investment so long os it was a fair value and you could afford to carry it on the monthly payments you knew you could make and stay within your family budget. You know what the annual cost is because you can calculate it.

At least 999 people out of 1,000 do not know what is the annual cost of a highway surface. If they would draw an analogy with their action in purchasing a house in which to live they would see that it consists of the annual interest on the investment, plus maintenance, plus depreciation, plus operating costs. In the case of the house the annual interest on the investment is the interest on the mortgage plus the interest on any notes or contracts over and above the mortgage. In time the house is fully paid up and interest no longer accrues on the investment. This is the case also with highway work. I grant that purchasing a house as a home is a different matter than purchasing a house as an investment. In this discussion I am considering the purchase from the point of view of the annual cost to you.

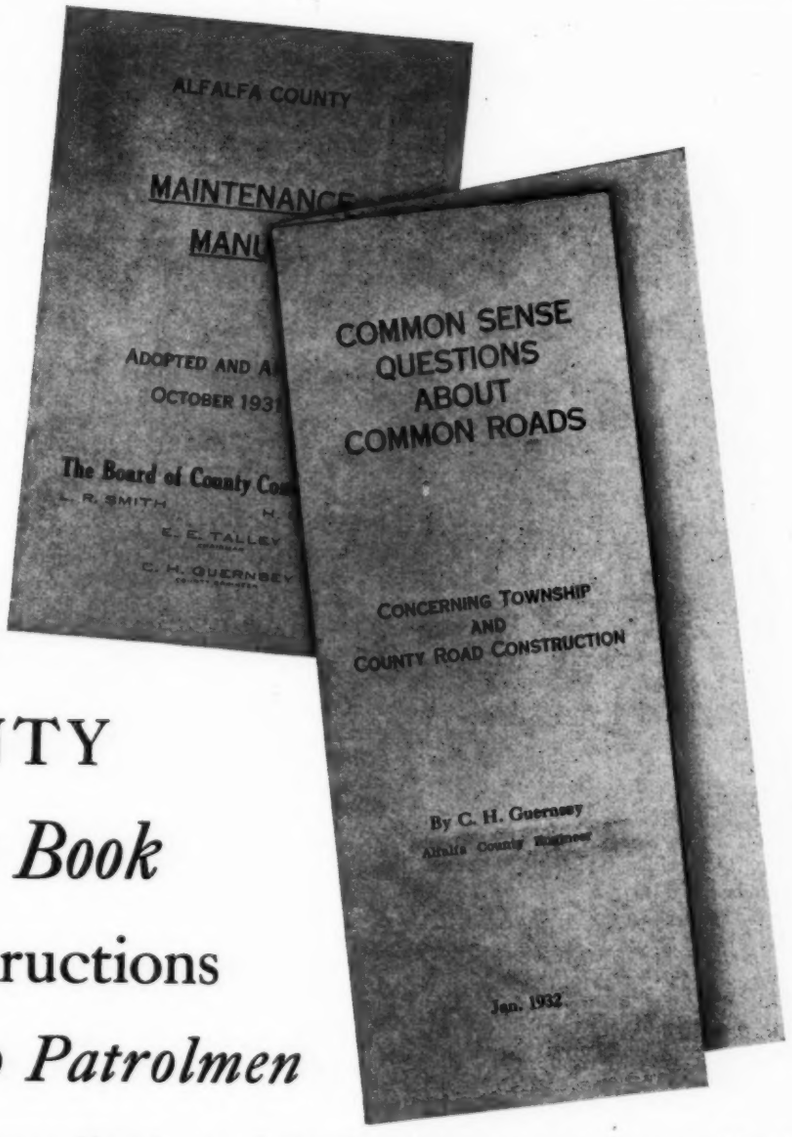
The next item, maintenance, is of the same nature in both cases. It is an annual expenditure for keeping the properties in a usable condition. Depreciation in the case of a house is evident, as it is in the case of a highway surface. To properly calculate it you should establish a figure in years as the economic life of that house and then deposit an amount each year in a sinking fund that will rebuild it at the end of its economic life. Likewise with a road surface. This annual deposit is called a reconstruction annuity and is a definite part of the annual cost. Then, also, in both cases, there is the small annual cost of operation.

While the first cost in both cases may be a relatively large figure, you are not much interested in that (so long as it is a fair value or, as has been the case in the last two years—a bargain) as you are in the cost per annum to you.

So, in thinking about highway work, think in terms of the annual cost and then apply the logic of savings to it and you will see that highways pay for themselves, annually, and are, therefore, a logical expenditure. The savings realized through driving your car on improved roads rather than on unimproved roads is as real a saving as that realized by using storm windows on your house.

Because there are so many motor vehicles operating on the highways, the saving is sufficient to build more than double the amount of roads that are built an-

County and Township Roads



OKLAHOMA COUNTY *Issues Book* of Instructions *to Patrolmen*

ALFALFA County's Highway Maintenance Manual and instruction guide for patrolmen was adopted by Board of County Commissioners on October 1, 1931. The board is looking for men with the following qualifications:

1. One who will get out on the road at the proper time when blading can be done to the best advantage.
2. One who will not patrol when it is unnecessary.
3. One who thinks more of his road than of his own pocketbook.
4. One who will keep his blade in the ground deep enough to plane down road roughness; and has the horse power to do it.
5. One who will keep his blade at proper angle.
6. One who will not stop long and visit while on duty.
7. One who will rest or "blow" his team near a culvert where he may use shovel or weed knife, while team is "blowing."

While these are the essentials of a good patrolman, your County Commissioner must also have qualifications so as to direct the work.

He should study his highways minutely, versing himself with every flaw and defect of his roads, make frequent inspection trips over his system, should be in constant touch, and be able to talk intelligently with each of his patrolmen, advising them "off hand" just where his road is good or bad and suggest remedies for the same.

Time to Patrol.

There is a certain time after a rain when the road will work the best. This time during which a road will blade the best is only a few hours sometimes, and is a very short period of time, depending on the season of year and whether or not there is any wind after rain. A road is too wet only a short time (usually) before it is just right, and it is "just right" only a short time before it is too dry when patrolling cannot be done to best advantage and to try to do so is a measure of inefficiency.

There may be emergency situations with every man when it is or seems impossible for him to be on the job when patrolling should be done at the time the road will work the best. When such emergency situations do arise, IT IS THE DUTY OF EVERY PATROLMAN to arrange for a substitute properly advised as to the methods in patrolling, or NOTIFY HIS COMMISSIONER that he cannot get on the road at the right time, letting the Commissioner know in time to arrange for someone who can.

How Often to Patrol in Rainy Season.

There is with this job as in everything else the need always for the use of good judgment. Whether he needs to get on the road after every rain, depends on how frequent are the rains and his good judgment in the need of the work, the main thing being a good road for the least maintenance expense.

There are times when the judgment of a good patrolman as to the work needed, must be supplanted by contrary instructions from the Commissioner, and this can happen easily when the money is getting low. (The County Highway appropriation for maintenance.)

Traffic Safety.

Keep weeds down from around the headwalls of culverts, and bridge approaches, as well as such places like the corners of intersections where high weeds obstruct the view of traffic in the opposite direction.

Any part of the blame for the death or injury of another person is a serious thing. This can be kept free of the county or patrolman when the visibility of the road is O. K.

In addition to high weeds there may be limbs of trees which should be cut off, or locust sprouts kept down with heavy corn-knife or regular brush-hook.

END POSTS on old narrow culverts should always be kept in place, and of some light color that will show up in light at night. These end posts are needed generally on all old township culverts found on the road at the time it was taken over as a county highway, and which has not yet been replaced by a county culvert.

In some localities theft of these end posts seems a common practice. Where theft takes place often, try using old discarded patrol blades set or driven in the ground as posts with broad side looking to the driver, and painted with white or aluminum. All narrow culverts and small bridges where necessary should have bright looking end posts. The minimum height of post should be height of car headlights above ground, and always free from surrounding weeds.

Road Surface.

The crown of the road (the travelable surface, together with drainage, is, of course, always the first in importance in all highway maintenance. In blading the crown after a rain, a good patrolman usually has a keen eye for all LOW SPOTS however big or little they may be, that hold some water and do not drain well. These LOW SPOTS may take only a shovelful of dirt, or they may take a slip-full or need a fresno, but whatever they need, they need it, and it should be done.

Low Spots.

It must be remembered that low pressure tires on high speed cars and trucks kick out low spots far more than we imagine. A small low spot can get to be a big one in no time. Often a shovelful of dirt may save a fresno full later on. By putting blade square with the road, and turning team a few tmies at a low spot, the filling may be done by patrol only. In this way the patrol acts as a fresno.

Blade.

The depth of the blade in the surface of the road should be deep enough to plane off most of the surface roughness, moving a little more than enough dirt to fill any dents in the road left under the blade.

The necessary depth varies some with the different kinds of soils. It is the skimming or sliding like a sled over a dry road that marks down a patrolman on the scale of efficiency.

Ditch and Shoulder.

Cleaning weeds from the ditches and shoulder slopes should be done at least once in the spring and once in the fall. The spring cleaning should be done in the best judgment of the patrolman, weeds may be controlled to best advantage. If more than one spring cleaning is needed consult your Commissioner.
so deteriorated sometimes that it is economical to have

The cross-sections of some county highways become a big grading outfit shape up the road for the patrolman. When this is deemed advisable consult Commissioner.

Culvert Drainage.

The middle of the road is not the only duty of a County Highway Patrolman.

CULVERT DRAINAGE always needs inspection, if not attention. The clear get-away of water through a culvert is always a matter of importance. Drift and tumble weeds easily stop up the up-stream end of small culverts and pipe. On larger culverts the down-stream end is the first place to look as to drainage clearance. Look at the fence at the down-stream end of a culvert and see if the water is getting through all right. Usually the ground under this fence is little higher than the field or pasture below, and the path the water takes is not always cut through under the fence as it should be.

Tumbleweeds.

This is also a matter that is often overlooked by a construction crew before leaving a new culvert, though it is important and should be looked into by the patrolman to make sure. If the water-way size of a culvert is as it should be, then if there are no obstructions to the free flow of water out of it, there is no fear that water will get into it all right, in practically all cases.

Down-stream Fence.

HOG WIRE on the fence on the down-stream end of a culvert presents a problem in letting the water out. Some agreement with the property owner should be reached about such a condition. In the up-stream fence this does not matter so much since it does not hold the water in the ditch or road.

Culvert Cleaning.

If there is not free get-away of water through culvert, the slowing up of the water in culvert will cause heavy sedimentation of the silt brought down off fields above, and you will then have a frequent and undesirable job of cleaning out the culvert.

ANOTHER BOOK published by the county gives the layman an idea of the duties of the engineer by means of a series of questions. The questions are unanswered and worded in such a way as to indicate the value of engineering supervision of road and bridge work.

SHOVEL MAINTENANCE.

Every Alfalfa County Patrolman should carry both a shovel and some kind of weed knife.

INSTRUCTIONS.

Intersections should be kept filled with dirt, and drainage at intersections is always needing attention.

Water from the side-ditches can easily spill out over the road at intersections, and this has a doubly bad effect on the road because it affects two roads instead of one.

The intersection is a spot in the road with double wear, and gets the dirt kick-out in criss-cross directions. This alone tends to make them rough and the rougher the more the kick-out. And the more the dirt is kicked out and the more the wind blows, the lower the road becomes, giving the side ditches better chance to slop over at intersections, which in turn washes away and makes it still lower and rougher. Give attention at intersections.

NON-BLADING TEAMWORK.

Using slip or fresno, without authority of County Commissioner, mowing shoulder, and ditches, etc., and extra help.

A patrolman should not do extra work or employ extra men without first consulting his Commissioner, except it be in case of emergency, such as washouts, etc.

The Commissioner knows just how much money has been allotted him for bridge construction, for dirt construction, for maintenance, for grading, and with this money he has mapped out a year's program, which program is so arranged as to be for the best interest of his district. Therefore it is necessary for him to say just where and how the money is to be spent.

Editor's Note

Alfalfa County's engineer, Mr. C. H. Guernsey, is an associate member of the American Society of Civil Engineers and president of the Oklahoma County Engineers' Association. When forwarding these books to us he made the following comment:

"Alfalfa County earth road maintenance has always been on a basis of part time employment of farmers using horse-drawn patrols. By patrol work only at such times when it may be done to best advantage are we able to have good roads at approximately $45.00 per mile per year, which cost is considerably under that of most counties on earth-road maintenance in this section."

COMMON SENSE QUESTIONS ABOUT COMMON ROADS.

These few questions are asked, that in answering them, there may be stimulated a general interest in the fundamentals of sound road construction practice on the part of anyone having anything to do with Township or County roads in Alfalfa County.

These questions have to do only with the A-B-C's of road economics. There is nothing technical in them, in the sense in which we usually speak of things technical. Only good "horse" road engineering sense is involved, which of itself is nothing more than economics, which in turn means nothing more than the business of "looking out" for SAVINGS, and to save in order that it will be A SAVING IN THE LONG RUN.

Note: In a prairie country such as is Alfalfa County, we are strangers to the ordinary problems of highway alignment and grade requirements always found in country not so level, where problems in earthwork alone, such as the necessity to hold waste, borrow, and overhaul to the minimum; are intricate to say the least.

Therefore in this county the question of DRAINAGE and STRUCTURES claims attention. For drainage problems can easily be deceptive by reason of being in an apparently flat country. The following questions are only a few of the many that may be asked, and deal only with drainage and drainage structures, on common, ordinary county and township roads:

1. Why is it that we so often find old culverts of extreme differences in size, all on the same "draw"; and openings on a creek all the way from a culvert pipe to small bridge and then pipe again on the same creek?

2. In the above question, if the township sizes are large enough, then the state or county has wasted money evidently. And if the county size is right, then the township has wasted money in insufficient sizes and inadequate drainage.

If the size of the opening required has been the result of someone's opinion, then why should there be so much difference in opinion if opinions are reliable?

3. Has it ever been necessary to tear out an old township culvert and put in a larger, or place a larger alongside the old inadequate one, etc? If so, have you ever figured out in dollars and cents the waste by so doing?

4. Guess and try methods seeming to be expensive, is there any old and reliable, tried and proven method of "sizing" culvert openings, and if so, why is it known to be reliable?

5. What is the common, ordinary, good horse sense method of determining the net opening required for a bridge?

6. Why is it necessary to increase the size of a corrugated metal pipe culvert by approximately 35 per cent in order that it may carry as much water as a concrete or clay pipe?

What consideration, then, still causes metal pipe to be economical? Compare hydraulic efficiency of rectangular culverts with round pipe.

7. Why is it that by rounding off the square corner at the entrance end of any culvert pipe (such as may be done with the upstream headwall) will increase the carrying capacity of any pipe about 10 per cent?

The answer to the above question gives reason also why the capacity of any culvert pipe is increased from 18 to 20 per cent by having angular entrance wingwalls over no entrance headwalls at all.

8. If you had two water-sheds of equal size, one narrow and long, and the other more nearly square; would you consider this difference in sizing openings for both?

If one of these watersheds or drainage areas has much greater slope to its main channel than has the other, then what would govern you in sizing water-way or opening needed?

Note: In the above question it is assumed that soil classifications are similar. Effects of soil differences, explained in answer to Question No. 4.

9. The sizing of culverts and small bridges greatly affects the public's pocketbook. Everywhere thousands of dollars are spent for culverts and small bridges. It is a most common and prevalent item of cost, a real saving here is no insignificant thing over a period of years.

Now, having considered size of net opening called water-way, what two other items should be considered about culverts and small bridges?

10. Under present condition of car and truck, and trailer traffic, why is it usually economical to consider the road-way afforded by a culvert, in terms of what may be called traffic lanes?

11. Is it ever objectionable for a township culvert to form a high bump in the road, and how can this objectionable feature be avoided?

12. Considering public safety, and strength of materials; what proportion of total truck load is carried by the rear axle?

Note: In culvert design this question is important since both axle loads do not come on short span culverts at same time.

13. Laid on edge, compare the strength of a common lumber 2 in. x 4 in. with that of a 2 in. x 8 in. How many times stronger is the latter than the former? If your answer is two, try again.

14. For example, if a culvert floor span of 7 ft. will withstand a single load of 2,000 lbs., how may we know accurately that the same floor will withstand a load of 3,000 lbs. if the span is 5 ft. instead of 7?

The principle involved in this question is both elementary and important in culvert design on township or any roads.

15. In the use of treated timber, why must the preservative be a poisonous germ-killing agent, penetrating the wood, rather than a surface coating like a paint?

16. In reinforced concrete construction, why is it an utter waste of expensive materials to place steel in the center or middle of the concrete?

17. For very fundamental reasons, toward what side of the concrete member should steel be placed always, and in which direction and how much?

18. With big truck traffic and heavy loading continually increasing why should not bridges on main county roads receive the same attention in the matter of structural design for the class of traffic handled, as is given state bridges for its class of traffic, or is given any permanent improvment of any kind?

This question deals with the apparent safety of many of the early bridges. A heavily loaded truck may pass over an old bridge followed by a light automobile going into the creek with the bridge; reason for this is the old principle in mechanics that it is not the last blow of the hammer that breaks the rock.

19. Why is it that a bridge built on ("skew") an angle of 45° with the center line of the road, can afford only 65 per cent of the water-way afforded by same length of bridge when the supports are at right angles to the road?

And, when is a skew bridge or culvert considered necessary?

20. For what reason does a small quantity of water on a relatively steep slope cause so much erosion and washes and caves deep ditches when a much greater quantity of water with less slope will do only small damage by erosion in comparison.

What slope must a ditch have to start "washing" in ordinary soils.

COMMON SENSE QUESTIONS ABOUT A COMMON MATERIAL OF CONSTRUCTION.

Shall We Save in Costs and Know When We Are Doing It?

(Economic Questions Concerning Concrete, Equally Applicable to Lumber and Steel.)

21. What is the difference between cement and concrete; cement mortar and concrete?

22. Does the different strengths of different kinds of concrete make any difference? If so, how does the difference affect our pocketbooks?

23. How do we know whether stronger concrete and less of it, will turn out to be a saving?

24. How do we know that any certain strength can be determined in advance?

25a. What part does crushed stone play in concrete? Does it save any money?

25b. What causes a load of moist sand to be much lighter in weight than is the same load of dry sand?

And when you buy a load of sand what part of a load of "solid" sand do you get? In other words, what considerable portion of the load consists of vacant spaces between the grains?

Note: This question involves an important element in economic use of concrete of any kind anywhere. How does sand and rock compare in this respect?

26. What must be the price of cement, or the freight rate on rock, when it pays not to buy graded stone for concrete?

27. Of what use is it to pay any attention to the amount of mixing water used?

28. What does the proportioning of the mix do anyway? Does it affect strength any? Or does it affect yield and workability only?

29. When you pay out money for steel reinforcement bars, do you do so intelligently?

30. When you flood the carburetor on your car you are giving the engine more gas than it can use. Likewise, how do we know when we are giving the concrete more steel than it can use to balance things up for the strength needed, or more concrete (of the kind it is), than the steel needs? Does location of steel amount to anything? Why?

31. Have you wasted money in making your bridge or building stronger than it needs be? Or is it strong enough?

32. Is the answer to the previous two questions just someone's opinion?

Should good money be spent on costly material on the basis of any person's guess? How can we know and not be in the dark about these things?

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Farm-to-Market Road Problem in Pennsylvania

How Pennsylvania is solving on a large scale the problem of farm-to-market roads through the improvement of 20,000 miles of township roads by the state will be the subject of an address by S. S. Lewis, Secretary of Highways, at the Tenth Annual Asphalt Paving Conference to be held at New Orleans during the week of December 5.

This type of practical farm relief, which Governor Pinchot made a successful issue in the 1930 election, is demonstrating its feasibility both in magnitude of results accomplished to date and economy of operation, since already 3,659 miles of the system have been completed at an average cost of $5,300 per mile, affording to the farmers dustless, mudless roads usable throughout the year.

Mr. Lewis' address will form part of a program designed to show how progressive states are solving the low cost road problem.

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The Rules Again

Now comes the suggestion in *The Earthmover* of a thinking contractor regarding the rules of the U. S. Bureau of Public Roads when he was told that he would have to use hand labor instead of machines:

"Look here," he said, "if you really want to save the taxpayers' money, give me a list of men whom you want to employ. I'll let them sit on the fence and watch my machines."

This suggestion is really a good one. Think it over, gentlemen.

ROAD Marking *in Cuyahoga County, Ohio*

Showing Comparative Types of Signs.

OLD fashioned street markers with two small signs on a seven foot post are ideal for the pedestrian. When he gets to an intersection he can not only read the sign if interested but it is mounted high enough to eliminate danger of knocking his hat should he pass too close without seeing it. These old markers were adequate in the days of the horse and buggy but with present motor traffic they fall far short of giving the desired service. They are placed too high for the motorist's lights to reach them at night and are placed at the actual intersection they are to mark. Thus, by the time a traveling motorist can read it he has already passed it.

Cuyahoga County, Ohio, has solved this problem in a manner that has eliminated the former confusion and annoyance of small and poorly located signs.

All intersections in the County have been marked plainly and in such a careful manner that "he who runs may read."

As a motorist speeds along he is greeted by an attractive sign which announces in bold but dignified letters the name of the intersecting road and further states that the road is 500 feet ahead. Those desiring to turn have thus received advance notice and can accommodate themselves to the proper traffic lane before actually reaching the intersection. Each sign carries at the top in smaller but plain letters the name of the road along which it is erected. The signs are erected at the proper height to catch the rays of motor lights and are painted yellow and black (a combination whose high degree of visibility has been proven by scientific tests and practical experience).

Mr. J. H. Harris of Cleveland, one of the Commissioners of Cuyahoga County, is credited with initiating this splendid marking and the many favorable comments from both residents and visitors attest to the undeniable fact that it is an excellent system.

Signs Are Placed So Headlights Strike Them

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All Connecticut Towns Connected by Hard Roads

Thirty years ago an Amercan engineer, upon returning from England, said that he had been most impressed by the fact that he had not seen a single mile of English public road that was not surfaced with macadam or something better. He added that in America that ideal could never be attained, because the expense would be prohibitive in a "country of such magnificent distances."

"Within the last generation the highway system (of Connecticut) has been developed to such an extent that it is now possible to go from any town in the State to any other on a good hard surface state highway." We quote from "A Survey of Motor Vehicle Traffic in Connecticut in 1931" by the Department of Motor Vehicles. Probably not more than one other State in the Union can show a similar achievement. Yet it is reasonably certain that within another generation at least half of our total road mileage will be hard surfaced.

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STATE HIGHWAY CONSTRUCTION IN ILLINOIS.—Illinois state highways completed in 1932 up to Sept. 21 amounted to 1,126 miles, of which 788.60 miles is of high type pavement and 337.65 miles is gravel or macadam, including 1.02 miles of temporary gravel on the state bond issue system.

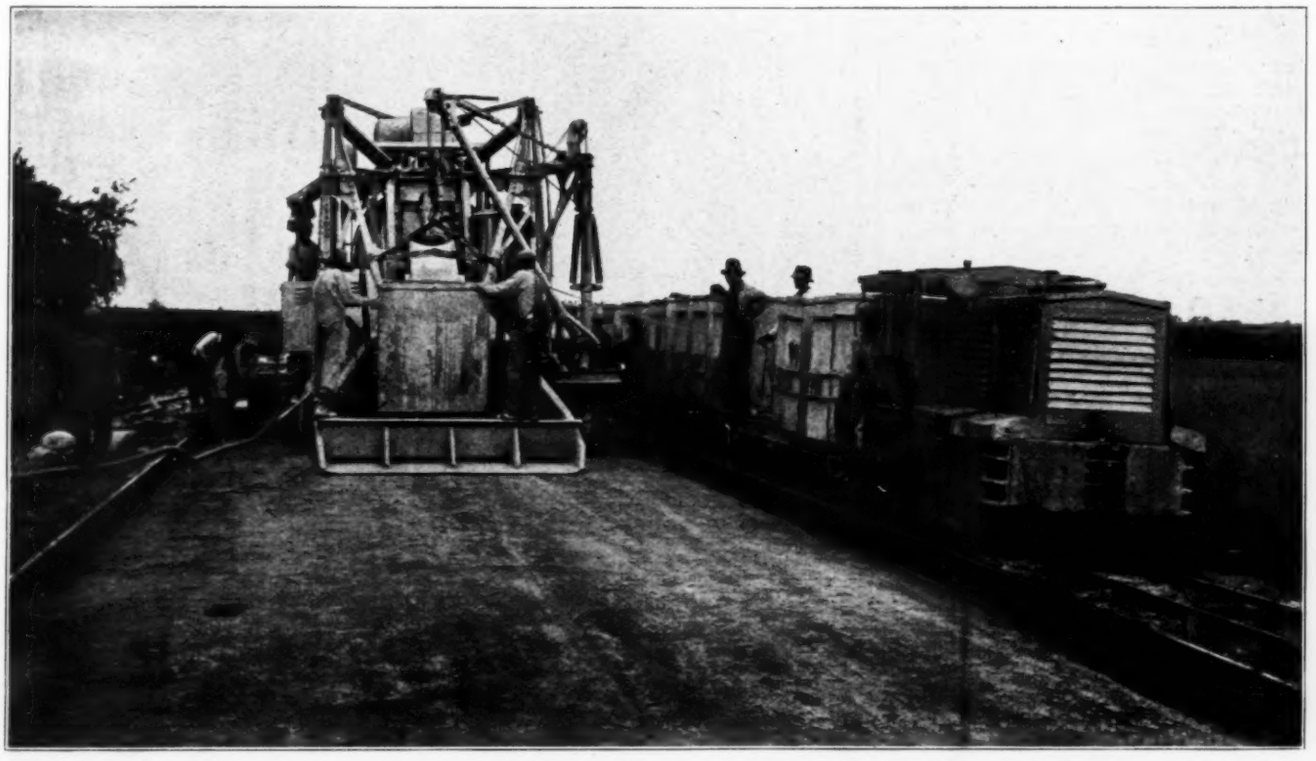
BEFORE

Years ago rock was "knapped" by hand and is yet today, as per instructions of the U. S. Bureau of Public Roads, with a round steel ball on the end of a wooden handle. It is slow and laborious work; not to mention the high unit cost.

Remember these days? Thanksgiving weather was no deterrent for concrete manufacture in 1909. These men lost no sleep over water-cement ratio or fineness modulus.

AFTER

Today on economic construction, portable rock crushers are hauled from place to place by a motor truck. What will be the developments in 1950? The gasoline engine drives a crusher that does the work of many men at a low unit cost.



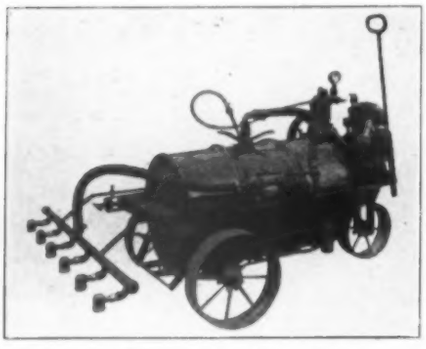
Fundamentally—similar; but technologically and practically—different. Modern methods have reversed the processes in vogue in 1909. Again we query—what in 1950?

New Equipment and Materials

A New Road Emulsion Sprayer

A new "direct-from-the-drum" sprayer for the application of Colas asphalt emulsion, has recently been announced by the Tarrant Manufacturing Co. of Saratoga Springs, N. Y., designed to supplement the older Colas hand pump machine. This patented sprayer is available in two types: The type "B" which will supply either one or two hand hoses and the type "C" which can be used with a hand hose or with a spray bar for sheet application as with a miniature tanker.

The type "B" sprayers are stated to have been shown under actual working conditions, to apply from 1,100 to 1,400

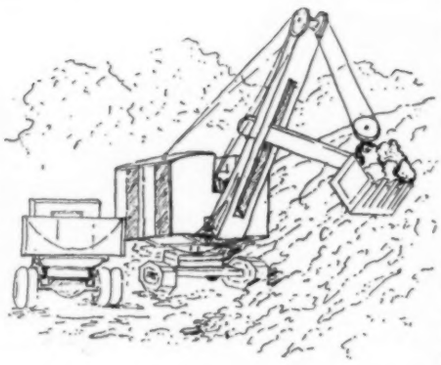


Tarrant Type C Emulsion Sprayer

gals. per ordinary working day, using a single spray hose. It also is stated that with the type "C" sprayer, employing the spray bar which gives approximately a 5-ft. width of application, a greater gallonage is, of course, possible as a drum of material is applied in less than 3½ minutes. These sprayers, intended for small construction and maintenance with Colas, include in their design, many novel and practical features. All connections are arranged to make up and take apart by hand and but a few moments are required to load a drum of Colas, make up the couplings and start spraying. Bulging of the drum heads in these machine is prevented by a simple disc reinforcement, and the low spraying pressure is automatically and accurately regulated. Ample air is supplied by a light weight, air cooled pump, driven by a small gasoline engine. This engine is equipped with a high tension magneto and a throttle governor. The discharge tubes provided fit both 1½-in. and 2-in. side bungs, which are regular standard drum sizes, and the heads of these tubes swivel to facilitate making connections.

By mounting the sprayer on three wheels the necessity of lifting the end of the machine to move it, or of blocking the wheels to prevent its tipping over, is eliminated.

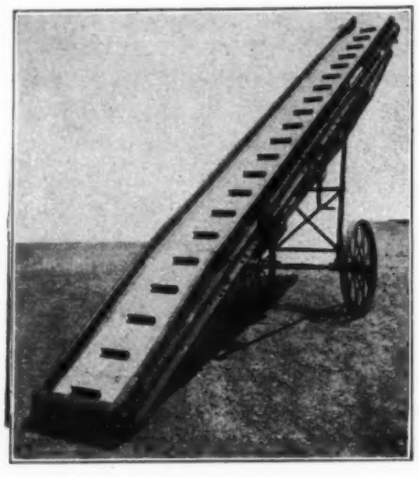
Every detail of these sprayers has been carefully worked out under actual field conditions, with the assistance of Colas engineers.



New Portable Conveyor

A new portable belt conveyor, embodying numerous improvements over its last year's models, is announced by Link-Belt Co., Philadelphia. Among other features, it incorporates fixed steel retaining sides extending the entire length of the conveyor, thus preventing lumps from spilling over the sides of the belt at any point.

To obviate a common source of trouble experienced with portable belt conveyors of this general type, the foot end has been improved to keep material away from the



New Portable Conveyor

return run of the conveyor belt. Another feature is the new arrangement of the foot end plate, permitting the convenient use of the machine without this plate, when desired, minimizing labor in feeding, and serving to speed up loading.

The other major features are enumerated below:

Conveyor length, 21-ft. centers; belt, Link-Belt service brand, 18 or 24 in. wide; idlers, all-metal troughing type with antifriction roller bearings; shaft bearings, all bronze-bushed; head pulley, 9-in. diam., pulls without slipping; foot pulley, bronze-bushed, running loose on shaft, adjustable from outside to permit training of belt; lubrication, Alemite throughout.

The machine is suitable for the economical loading or unloading of any loose material. Various modifications are possible, such as gas engine operation, omission of truck wheels, suspension of conveyor from a trolley, omission of side plates when handling bagged material, etc.

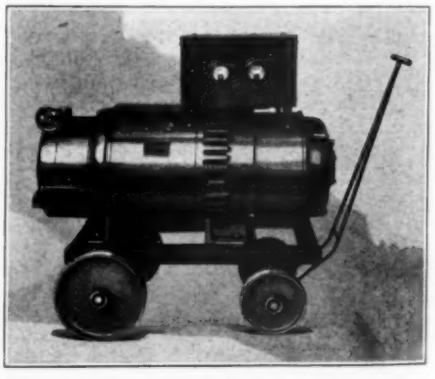
New Portable P&H Hansen Arc Welder

A new P&H Hansen gasoline driven arc welder has been announced by Harnischfeger Corporation, 4404 West National Ave., Milwaukee, Wis. This 300 amperes capacity, 42-hp. gasoline driven unit, and its companions, are built for quick accessibility and can be hooked onto a truck or pleasure car and pulled to the location of the work.

Gas engine driven P&H Hansen arc welders are supplied in the 100, 200, 300, 400 and 600 ampere sizes in the stationary and popular portable types. Engines of all sizes run at 1,750 r.p.m. Welders are powered with Waukesha engines. These sturdy, dependable engines are equipped with Ricardo heads, pressure oiling systems and built-in governor. A large radiator insures ample cooling capacity. Self starters eliminate the cranking act.

A flexible coupling joins the arc welding generator to the gas engine. Each generator is equipped with a panel board containing flush type volt meter and ammeter, and cable terminal studs with large hand screw clamps. The single, easily operated control for reglating the welding current, 40 and 25 volt, is mounted on the commutator end of the generator. If desired, an auxiliary generator (1½ kw., 120 volt dc. generator on the 200 and 300 ampere size units, and a 2¼ kw., 120 volt dc. generator on the 400 ampere unit) can be furnished. This generator is mounted on end of the welding generator and furnishes current for light and tool operation.

Gasoline engine driven welders are mounted upon an arc welded steel base and completely enclosed. Protective side covers are easily removed, yet are weather-



New P&H Hansen Gasoline Driven Arc Welder

proof and give ample protection against the elements.

Portable gasoline engine driven welders

in 100, 200, 300 and 400 ampere sizes are mounted upon spring suspension and wire wheels with pneumatic tires. The portable 100 ampere gas engine driven unit can be mounted upon two wheels. Larger sizes are mounted on four-wheel units.

FWD Announces Improvements in Standard Line for 1933

The Four Wheel Drive Auto Co. of Clintonville, Wis., has announced a complete new line of heavy-duty trucks for 1933. The models range in size from the 2 to 2½-ton 4-wheel drive to the 15-ton 6-wheel drive, and incorporate many new improvements. Special mention is made of three primary models, featured for use in the major FWD markets; they are the

The CU6 FWD Truck

H6 of 2-2½-ton capacity, for road maintenance, the CU6 of 3½-4-ton capacity, for road building and snow removal, and the X6 for milk and petroleumn service. Each of these trucks incorporates the basic 4-wheel-drive principle of propulsion and such refinements as are applicable to their field of use.

The new model of the CU6 for 1933 has a decided improvement in appearance and many mechanical advantages over its predecessors. The new cab is of the areodynamic type with an internal sun visor and has all the appointments of a pleasure car, including rear-view mirror, windshield wiper, and a redesigned dash with indirectly lighted airplane type instruments in a unit panel. Side vents at either side of the floor board and dual rear windows provide ample air circulation for hot summer days.

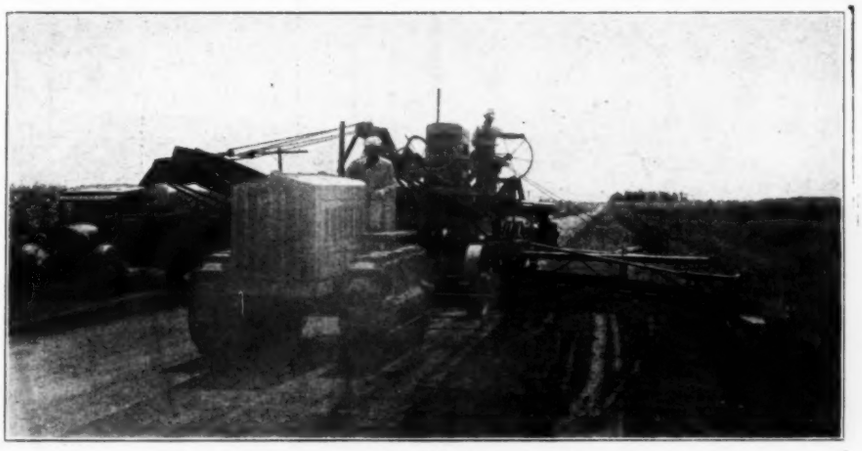
The motor in this model is a 6-cylinder 7-bearing crankshaft unit, rated at 91 hp. with a piston displacement of 411 cu. in. Of the L-head type, the motor has a Ricardo high-turbulence head and is unusually economical in operation. There are five speeds forward and one reverse in the heavy-duty sliding jaw clutch transmission, providing a speed of 32 miles per hour in the standard 7.35 to 1 gear ratio. Optional ratios give speeds of 19.5 miles per hour to 41 miles per hour in high gear, depending on the customer's requirements.

The wheelbase is 147 in. with three others optional—that is, 159-in., 169-in., and 179-in. can be furnished if desired. The tread has been increased from 60 to 72 in. and the motor, transmission, etc., lowered 4 in., thus lowering the center of gravity and securing better roadability. The turning radius is also shortened considerably by the increase in tread width. The regular set-back front axle design is employed as in former models.

Western Shouldering Attachment

Western Wheeled Scraper Co., Aurora, Ill., has made another contribution to the road building industry. Heretofore, the shaping of shoulders along paved highways has been an expensive operation owing to the cost of removing the excess dirt. A shouldering attachment has just been developed for use with the Western No. 6 elevating grader, in place of the plow. It will build a shoulder true to line and grade, and at the same time will load the excess material for use in bank widening and other disposal.

This combination of machine and attachment gives the contractor an elevating grader for use in grading work and also an attachment that will shape and finish a shoulder.



New Western Shouldering Attachment

The shouldering attachment consists of a strong blade fastened to a frame that is rigidly attached to the elevating grader in place of the plow; an outer auxiliary blade for cutting the slope to the ditch, and a screw conveyor to carry excess dirt to the elevator belt for loading into trucks or wagons. This shouldering attachment can be fitted to machines already in the field.

The outer end of the main blade can be raised or lowered to form the required slope of the shoulder in the same way that the plow is raised or lowered. The inner end also can be raised or lowered when the contour of the pavement or some obstacle makes it necessary. As the top of the blade is 21 in. above the cutting depth and the screws of the conveyor are 5 in. above the cutting edge, a large amount of loose material is carried in front of the blade before the loading begins. This feature provides enough loose dirt to fill the smaller depressions.

The outer auxiliary blade can be adjusted to a variety of angles for cutting the required slope to the ditch. It also is adjustable horizontally, making it possible to cut and shape shoulders of varying width up to a maximum of 11 ft.

The screw conveyor is operated from the same motor on the machine that serves to elevate the load. This permits the operator to stop the machine and continue loading, should the dirt pile up. Should a low place need filling, it permits him to stop the screw conveyor while the machine continues to move forward, spreading evenly the material carried in front of the blade.

As the wheels of the machine run on finished pavement, a smooth cut results, at the depth to which the blade has been set. A spirit level on the blade and in constant view enables the operator to regulate the cut with exactness. It can be adjusted for any slope desired.

When writing the manufacturing company for information, ask for Bulletin W-32-D.

Lufkin Highway Drag Tape

This is a new steel tape, extra sturdy and designed especially for highway, railroad and other heavy work. It is offered by The Lufkin Rule Co., Saginaw, Mich., manufacturers of measuring tapes, rules and precision tools.

This 5/16-in. wide chain tape is of special tough steel, of extra weight, practically unbreakable. It has etched graduations, with black lines and figures and "Nubian" finish, as shown above. The markings and figures are prominent and deeply cut into bright high portions of the

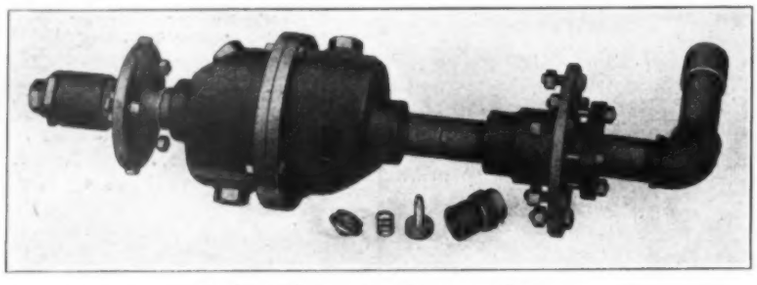
line itself, therefore most readable, and more permanent than other etched tapes or than those graduated on sleeves or babbitt. These markings will remain clear even after much dragging of the tape.

This tape is graduated to feet only, every foot with end feet in 10ths, and with half railroad gage mark at 2 ft. 4¼ in. from zero. It can also be had with extra foot before zero to 10ths. It has heavy brass end clips and a pair of rawhide thongs. It is made in lengths 100 to 300 ft., and furnished without reel or with sturdy metal reel. A conversion rule is supplied with each "Hi-Way" tape. This is a very handy 6-in. boxwood rule marked 10ths and 100ths of feet one side, inches to 16ths other side.

The Lufkin Rule Co. will gladly send circular to any interested party.

An Automatic Revolving Pressure Valve for Mixers

A water supply mechanism for use either on transit or stationary mixer equipped with water pumps is illustrated. In this installation the stuffing box and all other working parts are located *outside* of the drum and are kept entirely clear of the mix. The whole valve unit turns with the mixer. The construction of the valves is stated to be such that when the water pump is started a ½-in stream of water from each plug valve shoots clear through the mix to the inside body of the drum. The drum is thoroughly washed and cleaned after each load is discharged. The header which contains the plug valves is made of cast iron in two halves for easy installation. Four bolts fasten the two halves of the header together securely.



Borland Automatic Pressure Valve

The plug valves are so constructed that when the water is turned on the pressure is applied to the outside of the casing of the valves. There is no possibility of the valves clogging or letting concrete into the water line. As a double precaution the plug valves are made of a bronze material. Small holes in the face of the valve stems allow quicker opening of the valves. Valve stems do not project beyond the head of the valve seat casing. The unit is easily applied to all the mixers. This device is known as the Borland automatic revolving pressure valve.

Lima Improves Dragline

For the levee and drainage contractor, The Ohio Power Shovel Co., Lima, O., now offers the Lima type 601 heavy duty dragline built to meet the demand for fast operation.

More than five years ago Lima incorporated anti-friction bearings at every vital bearing point. Now, further to insure smooth and economical operation, Lima introduces helical gears throughout (with the exception of bevels).

Another important feature of the Lima 601 is the extra large diameter of the drums. Cable manufacturers recommend drums of 30 times the diameter of the cable. Lima has exceeded this and provided 32-in. drums for a 1-in. cable. The drums are of sufficient width to carry the usual amount of cable without double wrapping. The drums are mounted on alloy steel shafts and rotate on roller bearings.

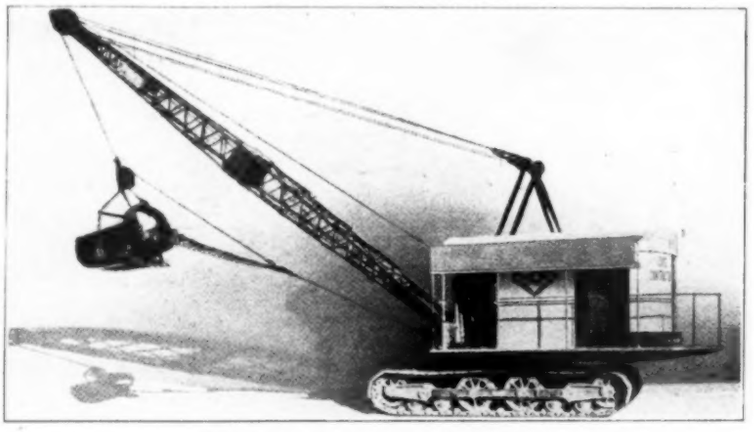
Independent clutches make it possible to hoist, travel, swing, steer, and raise or lower the boom all at the same time.

The synchro-power type clutch helps the operator. It is easy to operate, only requiring enough pressure to apply the power which is taken from a toggle-operated mechanism on the drum shaft.

The long crawlers (16 ft. 3 in.) with 30-in. treads provide the low bearing pressure of 9 lb. per square inch. The crawlers have the ends sufficiently elevated to enable them to climb through mud and over logs and other debris when necessary. The steering is accomplished from the cab with the rotating frame in any position. Full power is always available to either crawler for turning in wide or short radii.

The Lima 601 is furnished in 1½-yd. and 2-yd. capacities, depending on length of boom used. A special Lima aluminum dragline bucket of increased capacity can be furnished when greater output is desired. The boom is made of alloy steel, lattice type construction, thus affording maximum strength and minimum weight. Boom lengths range from 40 ft. to 70 ft.

The fairlead consists of four large sheaves mounted on roller bearings and attached to the revolving frame. The cables lead off the bottom of the drum, and the distance from the drums to the fairlead is 7 ft.

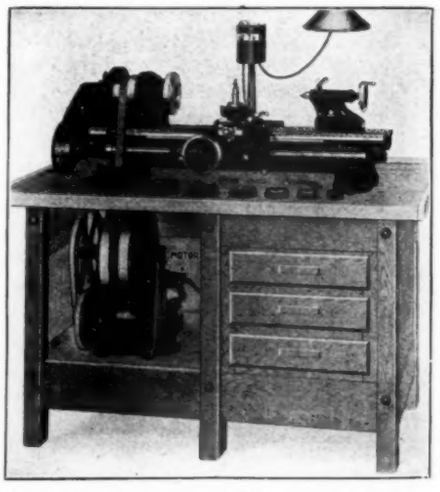


Lima 601 Heavy Duty Dragline

The power plant is a 120-hp. gasoline engine; however, a Diesel engine can be substituted for the gasoline engine when desired. Bulletins and photographs are available on the type 601 by writing The Ohio Power Shovel Co., Lima, O.

New Underneath Drive Precision Bench Lathe

Unique and entirely new in arrangement of the drive, is the underneath belt motor drive bench lathe recently developed by the South Bend Lathe Works. Drive for this lathe is by belt from a reversing motor mounted under the bench, directly beneath the headstock of the lathe. This down-pull feature provides an exceptionally steady, powerful and noiseless drive which insures accuracy and precision in machining work.



Underneath Belt Motor Drive Bench Lathe

Because of its compactness, convenience and safety, this bench lathe is practical equipment for engineering, experimental, repair and general machine shops. It is

of back-geared, screw cutting type available in 8-in., 9-in. and 11-in. swing size. It will cut all standard screw threads, right and left hand, from 2 to 90 per inch, including 11½ pipe thread. In addition to machining all kinds of metals, this lathe can be used for turning wood, hard rubber, and compositions.

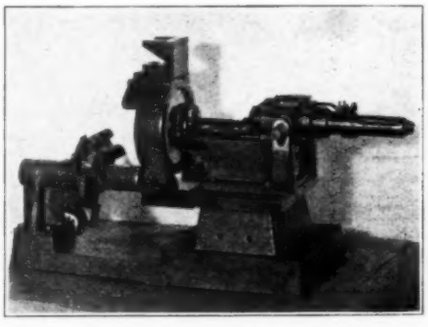
A new and convenient feature of this lathe is an easy-reading index plate which shows at a glance the proper gearing to obtain any desired tool feed in the wide range provided.

Among other features the lathe has six spindle speeds, drum-type reversing switch, graduated tailstock spindle, automatic feeds, and precision lead screw. Belt guard for the cone pulley is optional. Detailed information may be had by writing to the Technical Service Dept., South Bend Lathe Works, South Bend, Ind., mentioning the name of this publication.

Detachable Bit Grinder for Drill Steel

A bit grinder operated by compressed air has been brought out by The Marberg Co., 32 Mechanics Ave., Woonsocket, R. I.

The grinder is designed to accurately grind the cutting angles and gauge of the bit to the same pitch as the original construction so that no matter how many times the tool is ground, the angles and



Marberg Detachable Bit Grinder for Operation by Compressed Air

clearances are still perfect. The work slide is so constructed that it is practically impossible to grind an imperfect form and a skilled mechanic is not needed to operate it.

It is stated that for men who have had a few days' experience in using the machine the production on 1-in. steel will be 15 or more bits per hour, depending on the size and dullness of the bits.

The machine is made as light as is consistent with modern machine design and is readily portable. It can be transported in the back of any car or roadster and can be set up in tunnels, shafts, mines, quarries, etc.

The machine also is made for operation anywhere there is an electric line suitable for lights. A portable electric power unit also can be furnished.

New Large Capacity Crawler Wagon

A new crawler wagon especially constructed for drag-line loading, has been brought out by Trackson Co., Milwaukee,

Trackson "Levee Special"

Wis. This new Trackson product has a water measure capacity of 9 cu. yd., or 11 cu. yd. heaped materials, and provides approximately 40 per cent greater capacity in comparison with their standard 7-8 yd. wagon. It is intended for use in conjunction with larger sized drag-lines and crawler tractors now coming into general use on large earth moving projects, particularly on levee construction work along the Mississippi River.

Like the standard 7-8 yd. Trackson crawler wagon, the "Levee Special" is of the bottom dump, cart-type. Unloading takes place through the full-length bottom doors and consequently the load is dumped almost instantaneously with the release of the doors. Being of the cart-type, approximately 90 per cent of the total load is stated to be carried on crawler wheels with the remaining weight overbalanced onto the tractor through the rigid tubular tongue. In addition to the load being supported entirely by crawlers, the cart-type is claimed to have the added advantage of being practically proof against jack-knifing in descending steep grades, such as are found on levee construction work.

The Trackson "Levee Special," according to the manufacturers, has several features new to crawler wagon design. The crawler wheels, for instance, are so constructed to equal the rolling efficiency of a pair of huge wheels approximately 48 ft. in diameter. The arch in Trackson crawler wheels which makes this comparative efficiency possible is readily renewable at low cost. Crawler wheels that have been in service for over 5,000 hours have been completely re-arched and are stated to be in as serviceable and easy running condition as when new.

New Elevator Bucket

A new design of elevator bucket for heavy-duty work is announced by Link-Belt Co., Indianapolis, Ind. The new bucket, to be known as Style "AAP," is made in all the popular sizes, such as 8x5, 10x6, 12x7, 14x7, 16x8 and 18x8, and its

Style "AAP" Elevator Bucket

principal features are summarized as follows:

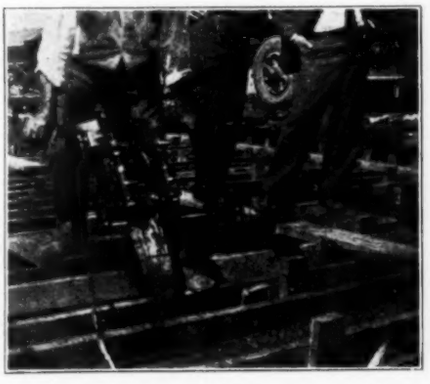
1. Heavy Back
2. Heavy Lip
3. Reinforced Corners
4. Front Reinforcing Ribs
5. Reinforcing Bead Around Ends
6. Middle of Lip Raised to Reduce Digging Strains
7. Made of Promal—the new, stronger, longer-wearing metal.

The company states that the "AAP" bucket embodies ideas gained from users of buckets in many fields, as well as an improvement in its foundry department in the method of pouring buckets, resulting in sounder castings than was possible with the old method.

Electro-Magnet Vibrators

Syntron Company of Pittsburgh, Pa., has just announced the introduction on the market of a new line of electro-magnet vibrators for vibrating concrete during construction work, the vibrating of material in hoppers to keep them flowing freely and for vibrating bulk material into containers, such as packages, barrels, etc.

The new Syntron vibrator is a very simple tool, consisting of a horseshoe magnet and an armature, the gap between the



Electro-Magnet Vibrator on a Job

armature and magnet being held open by springs. By using the patented Syntron principle of a pulsating current, the gap between the magnet and its armature is closed 3,600 times per minute on 60-cycle alternating current and the heavy mass of the armature moving at such a high speed sets up a powerful vibration that can be applied in a direct line toward any given mass desired to be vibrated.

The vibrator can be fitted with a handle and a vibrating spud for vibrating floor forms, flat slab placements or reinforcing bars in concrete products. Another attachment for the vibrators is a vise clamp for clamping the vibrator to the stud or whaler of building forms. The third attachment is a chain lamp for clamping the vibrator to a round column or a round sewer pipe mold.

The largest vibrator, Model V-120, can be fitted with a puddling board for vibrating mass placement of concrete.

These vibrators are built in various sizes for different applications.

Complete catalog information can be supplied upon request.

Special Feeding Device for Haiss Loaders Digging Topsoil

The supplying of topsoil for building lawns, renewing park areas, etc., involves the preparation of a finely, pulverized fluffy product, which will spread easily, rake smoothly and produce a lawn surface which will compact uniformly and stay level. To condition top-soil to this desired degree while it is being excavated, the George Haiss Manufacturing Co., New

Special Feeding Device for Haiss Loaders

York, N. Y., has developed the special feeding paddles for its standard loaders.

The standard feeding paddles of a Haiss loader were just as successful digging devices in topsoil as in gravel or other formations. Their picking effect, when applied to soil, tended to compact the material, since the latter with its mixture of organic matter, clay and loam, tends to be sticky. The special paddle fittings are broad, tooth edged and involve the reduction of the number of paddles from seven to four. It will be noted that this top soil digging equipment is bolted to the standard manganese steel paddle blades. It will be understood that any standard Haiss loader can be converted to a topsoil machine in a few moments.

▼

New Portable Plant Built in Units

Stephens-Adamson Mfg. Co. of Aurora, Ill., has developed a unit type portable crushing and screening plant of unique design.

The plant consists of a number of standard units designed for assembly in different combinations to suit the particular job or deposit in which the operator is interested. These units consist of receiving hopper and feeder, crushing unit, screening unit, storage hoppers and complete belt conveyor units. Each unit is self-contained, comparatively light and easy to move, thus simplifying the job of moving and setting up in new locations.

Apparently, the plant is designed to handle a wide variety of deposits. The crushing unit is built to take one or two crushers of various makes, types and sizes. Likewise, the screening unit will mount a single, double or triple deck vibrator screen. Where washed material is required, water sprays are added above the vibrator screen and a classifier or dewatering unit is inserted.

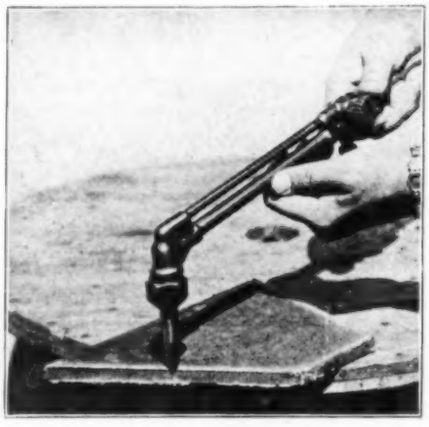
Gas or Diesel engines or electric motor drives can be furnished and where electric power is not available for motors, portable generator sets are furnished.

Several advantages are claimed for this type of plant. The various units, while quite compact, permit of plenty of headroom and clearance for inspection, lubrication, and adjustment. The operator has a wide variety of combinations from which to choose. Another economy claimed by S-A engineers is that additional units can easily be bought as needed.

▼

New Cutting Attachment for Welding Torch

To accord with the economic requirements of manufacturing under present conditions the Smith Welding Equipment Corporation, 2619-33 Fourth St., S. E., Minneapolis, Minn., has placed upon the market a new cutting assembly, or attachment, for a welding torch called the "Money



New Cutting Attachment

Saver" cutting assembly. To maintain the efficiency of the cutting assembly and yet to manufacture it at a considerably less cost was the problem involved.

In designing this cutting assembly the Engineering Department eliminated every customary feature, usually considered necessary in the manufacture of such apparatus, such as levers for the cutting oxygen, adjustable unions to change the position of the assembly in the handle, etc., and substituted for these features valves of the greatest simplicity.

The cutting oxygen valve is a triple thread, screw valve with knurled thumb wheel as shown, so arranged that it can be quickly opened and closed with the thumb. The valve forging has been reduced to the simplest possible design, the cutting tip automatically evens up the flames. The new assembly has been approved by the Underwriters' Laboratories. The result is a tool which can be sold at a low price.

Page Announces New Light Buckets

The Page Engineering Co., Chicago, Ill., announces the addition of a new series of buckets to its line. These buckets are being designated as class "LM" and are especially designed for digging light soils, such as can be plowed by two horses.

Light weight, strength and simplicity are the chief characteristics claimed for these buckets. They represent a combination of electric arc welding, plus hot riveting. The side walls and back are formed of thinner gauge steel plate than the bucket bottom—yet resemble one surface. The joints are "apron" welded and the seams are ground down smooth.

The arch and dump plates are likewise welded and securely hot rivetted to walls of bucket. The arch construction comprises two channels faced inwardly and joint welded, leaving no openings. The strength of this construction can readily be realized since one channel reinforces the other, giving utmost rigidity without excess weight.

The lip is of forged steel and heat treated. Cutting edge is machined and the plate connections are recessed to eliminate overlaps. The teeth are of new light Page design, fastening to the lip in a new and novel manner to prevent working loose or becoming wobbly. Lip construction is such that the bucket can be used with or without teeth.

The hitch plate construction, covered by patents, is such that the contractor can obtain any desired pitch to his bucket, since Page construction permits altering overhang or draft, without making it necessary to increase length of bucket jaw. It also limits wear at this point to two easily replaceable stock parts, namely, a clevise and pin.

The dump block, which is also patented, embodies a sheave which increases leverage on dumping cable, causing the cutting edge of bucket to lift first. Bucket can be lifted as soon as it is loaded, eliminating a long drag, and saving wear on drag brake, drag cable and dump cable. The sheave maintains the carrying position of bucket throughout the swing to spoil bank.

New Light Page Bucket

Other features comprise the patented one-piece loading cluster socket, wear-resisting chains, bulbed missing links and fittings.

This new series of Page "LM" buckets are available in all the sizes most generally used for light excavating (1-1¼-1½-1¾ and 2 cu. yd. capacities).